THE INCIDENCE OF PUBLIC TRANSIT SUBSIDY: A CASE STUDY

by

Richard L. Schulze

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Signature of Author.....
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and Planning, August 24, 1970

Certified by..... .....
Thesis Supervisor

Accepted by.....
Chairman, Departmental Committee
on Graduate Students

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Abstract

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One of the objectives of subsidizing public transit service is to provide cheap transportation for poor people. In order for any income group to have its cost of public transportation lowered through public subsidy, the savings from reduced fares must exceed the taxes paid to finance the subsidy. This study estimates the extent to which government subsidy reduced the cost of public transit for various income groups in a particular case.

For transit service in which the cost of a trip exceeds the fare, the amount of savings that accrue to any single income group will depend on the number of trips they make. The distribution of the total transit subsidy (in the form of cost savings) among the several income groups will be proportional to their share of total trips. A sample of transit trips revealed that people of all income groups are regular transit users. In fact, the lowest income group was the only group whose per cent of total trips was smaller than their per cent of the total population.

The distribution of the direct costs of the transit subsidy was determined by estimating the incidence of the tax which generated the subsidy revenue. Since in this case, the subsidy was financed from local property taxes, the incidence of direct costs was regressive.

Overall, the lowest income group paid as much in taxes as they saved from reduced transit fares. The income groups with annual income between four and fifteen thousand dollars had their cost of public transportation reduced at the expense of the highest income group.

This study concluded that in some cases, transit subsidy reduces the cost of public transportation more for middle-income commuters than for the poor. Because transit service is used by people of all incomes, general changes in pricing and provision of service will do little to specifically aid the poor. The manner in which the transit subsidy is financed is the prime determinant of the subsidy's impact on the various income groups.

Author: Richard L. Schulze
Thesis Supervisor: Philip B. Herr

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Chapter 1: Introduction

Setting

This is a time when the cries for increasing subsidy to existing public transportation systems are reaching a crescendo and when new transit systems are being planned on the basis of government subsidy. For these reasons it is appropriate to attempt the identification and measurement of the impacts of such subsidy.

The proponents of public support of mass transportation make numerous assertions about the value of new and improved systems.[1] A partial list includes: the reduction of street congestion, air pollution, and aggregate costs of transportation; the promotion of a more desirable pattern of land use development; the re-vitalization of economic growth in the central business district; the provision of transportation for low-income families; and the assurance that a variety of good transportation is available for all urban residents.

A public policy on transport subsidy that represents the "best knowledge" available should be the product of a several-step analysis. First, the actual effects of subsidizing a mass transit system should be estimated and then compared to the desired effects. Will subsidizing mass transportation re-vitalize the CBD's of American cities? A careful analysis of the way and the extent to which subsidy contributes to the accomplishment of this objective, if for example it is deemed desirable or necessary, should be a prelude to serious policy debate on its appropriateness.

Second, the other basic element of this policy consideration should be the meticulous scrutiny of the manner in which the subsidy would be financed. Often the merits of a subsidy program are lauded while the method of financing the subsidy is obscured or ignored entirely. This shortcoming can be grave if the subsidy's benefits to the target population are outweighed by the subsidy's costs to the same population. In such a case focusing on the flow of benefits and excluding the flow of costs would lead to a policy that is not only ineffective, but in fact, counter-productive. At the very least, the costs of subsidy and its incidence are important because they raise questions of equity: who should pay, and in what proportion, the costs of a particular public good or service?

Definition of Public Transportation

In this study public transportation is defined as that "service provided for the carriage of passengers and their incidental baggage on established routes and fixed schedules within cities and metropolitan areas usually on a fare-paying basis".[2]

Characteristics implicit in this definition are mass service and common carriage. The service is designed to meet the aggregate demands of large numbers of users, not the desires or preferences of the individual user. Normally, the transportation service provided is shared simultaneously by numerous riders.

The term 'public transportation' describes this particular characteristic of the transportation service, not the nature of the agency providing the service.[3] Both public and private agencies use subways, streetcars, motor buses, elevated rail transit, and commuter railroads to supply public transportation. An additional definition seems necessary. Rapid transit is defined as transit service operating completely on an exclusive right-of-way.

Focus of Study

This study analyzes how effectively subsidizing public transportation reduces the cost of passenger transport for low-income families. Essentially, the policy of subsidizing public transit for this reason can be viewed as an attempt to redistribute income from richer families to poorer ones. The questions posed by its review are: Are poor families helped financially by public support of mass transit? By how much?

Focus on the effectiveness of mass transit subsidy in redistributing income is justified by its centrality to the case for such subsidy. The strength of this observation rests on a review of the literature on the subject:

> Virtually the only rationale offered for maintaining transit fares below market levels is to provide cheap transportation for poor people.[4]

> Although the (transportation) system fails to serve the retired person... and the suburban housewife...the transportation problem is particularly acute for low-income persons in the center of our cities.[5]

> The argument for subsidy of public transit from the general revenue fund is strongest for the provision of service for the groups in the population for whom transportation by automobile is not appropriate. For the most part they are in the lower income groups... Provision of such service is not to be confused with the larger problem of providing transportation to and from work.[6]

> Indeed, one common justification of rapid transit systems is that they provide a socially desirable service for those too old, too young, or too poor to drive.[7]

Assisting the low-income families pay the cost of their transportation has been a primary purpose, or at least stated as a primary purpose, of subsidizing public transit systems. On these grounds the determination of its effectiveness is obviously important. Even if mass transit subsidy is proposed for any of a number of other reasons, some of which have been outlined above, the effect of such subsidy on the poorest in our urban areas is, or should be, of interest in evaluating a possible subsidy program. When public transportation receives governmental support for the purpose of re-vitalizing the CBD or reducing traffic congestion, the flow of costs should be constructed so that they do not impede the intended flow of benefits.

Scope of Study

By examining the details of a particular case, this study estimates how local subsidy of a public transportation system affects the various income groups. Of primary concern are: (1) the operating policy options of the transit authority which affect the flow of benefits, (2) the alternative taxation policies which affect the flow of costs, and (3) the net effects. The attempt is made to isolate and quantify the contributions of the variable elements to the net result.

A feature distinguishing this case study from other related studies[8] is that it includes the benefits generated by both the operating and capital expenditures of transit systems. The emphasis in these other studies has been on the distribution of benefits resulting from capital investment financed by local and national programs. It was generally concluded that the direct benefits of capital investment programs accrue disproportionately to the higher income groups, since most capital investment is made in extending rapid-rail service to the more affluent communities in the outlying areas of the metropolitan regions.

This study's consideration of benefits and costs is limited to those which are direct and can be measured in pecuniary terms. Essentially, the emphasis here is on how much the family money income in different income ranges is either increased or decreased by the transit subsidy. Con-

sequently secondary and non-pecuniary factors such as convenience, comfort, travel time, air pollution, contribution to the social and economic vitality of the city, potential for differing patterns of land development, and indirect value of transit access to schools, hospitals, parks, and employment opportunities are excluded.

This exclusion should not be interpreted as the author's judgement that these factors are unimportant. To the contrary, their consideration is absolutely essential to the formulation and selection of a policy governing transit subsidy. This effort is directed at shedding some light on a relevant factor of transport policy formulation not all the relevant factors.

Thus, this study makes no overtures to the problem of estimating the total value or benefit of subsidizing public transportation. Nor does it argue the merits of such subsidy or of any subsidy programs in particular.

Chapter 2: Study Framework

Time and Place

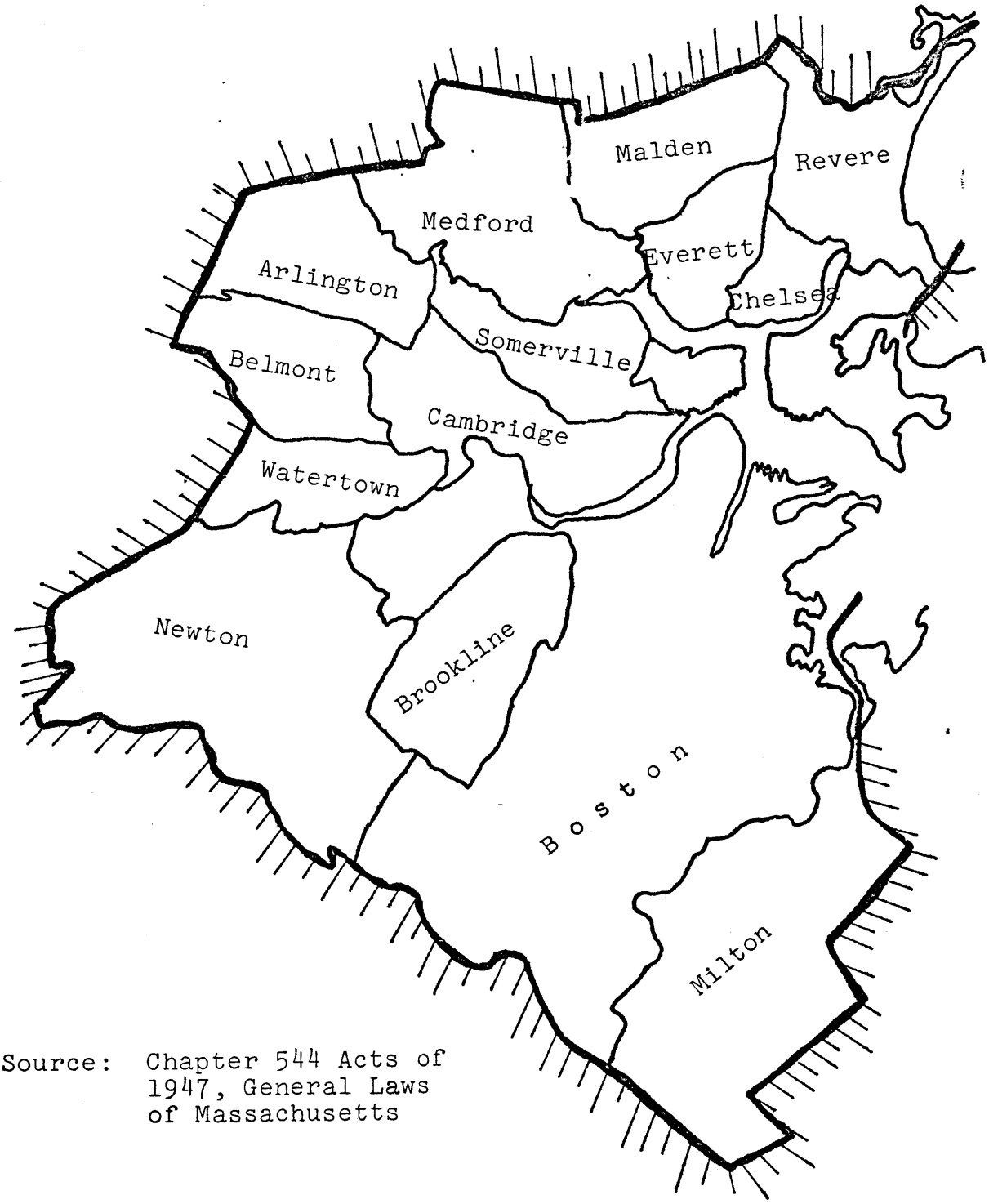
This case study analyzes the distribution of direct benefits and costs associated with public subsidy of the Metropolitan Transit Authority (MTA) of Boston for the calendar year 1962. The sole criterion in this selection was the availability of necessary data.

Description of MTA[1]

The MTA, a political subdivision of the Commonwealth of Massachusetts, was established by Chapter 544 of the Acts of 1947 for the purpose of acquiring and operating the properties and interests of the Boston Elevated Railway Company. This action was part of a nation-wide trend of transfering unprofitable transit operations from private to public ownership.

The MTA District consisted of the City of Boston and thirteen other inner cities and towns which were served by the defunct transit company. The member communities of the MTA are shown in Figure 1. The geographical boundary of this transit service remained essentially unchanged from 1918 to 1964.

The MTA is a public corporation with the usual accompanying powers some of which are subject to state legislative approval. A three-member Board of Trustees, appointed by the Governor, has responsibility for managing the MTA. The Trustees are aided by the MTA Advisory Board on which each member community is represented by its chief executive



Source: Chapter 544 Acts of 1947, General Laws of Massachusetts

MEMBER COMMUNITIES OF THE MTA DISTRICT

Figure 1

officer. The Advisory Board has no direct control over decisions affecting the nature and scope of MTA service, but it does possess a veto power over changes in fares.

In 1962 the MTA was, by far, the largest supplier of public transportation in Eastern Massachusetts carrying about 89% of daily transit traffic. Within its service district, a 123 square-mile area with a 1962 population of 1.4 million persons, the MTA was even more dominant with more than 95% of the public transportation business.[2]

MTA's service can be broadly classified as rail transportation and surface transportation. The rail service was provided by approximately 670 streetcar and rapid-transit vehicles on about 160 route miles.[3] The surface service, sometimes called feeder service to the rail lines, was provided by 890 motor and trackless-trolley buses on about 800 route miles.[4] In 1962 about 271 million passenger-trips were made on MTA's routes, 166 million by rail and 105 million by surface.[5]

Between 1947 and 1964 MTA fares were changed four times. Each change prompted by an ever-increasing deficit was an attempt to compensate for declining ridership with fare increases. The strategy was only partially successful since each fare increase decreased ridership.

It is important to note that the MTA Advisory Board, which consisted of locally-elected officials, had to approve fare changes. Obviously, an increase in the price of a public service is not very popular. Consequently, political

expediency lead to political inaction which ultimately resulted in increased public subsidy given the increasing deficit. This somewhat back-handed way of increasing subsidy was caused in part because the residents of the MTA District judged their officials on the basis of an "act of omission, not one of commission". An interesting question is whether or not the level of public subsidy in each succeeding year would have continued to increase had affirmative action been necessary for that to happen, instead of inaction?

The fare structure in effect in 1962 had been established the previous year. All rides on motorbuses and trackless trolley buses were 10 cents. Streetcar rides above ground were also 10 cents. Streetcar rides below ground and all rapid-transit rides were 20 cents. All transfer privileges had been eliminated.

There were several exceptions to these fare levels. The Highland Branch streetcar line had zone fares of 30 and 40 cents. Express bus service from Chelsea to downtown Boston had a premium fare of 25 cents. These two exceptions accounted for a small fraction of the 271 million annual passenger-trips. In addition, children age 5 thru 14 paid only 10 cents for any ride in the MTA system. In essence, the children fares were special rates only on the rapid-transit lines.

The financial condition of the MTA suffered considerably from increasing operating costs and declining ridership. The gap between total income and total costs was about 5 million dollars in 1947; fifteen years later the deficit had more than

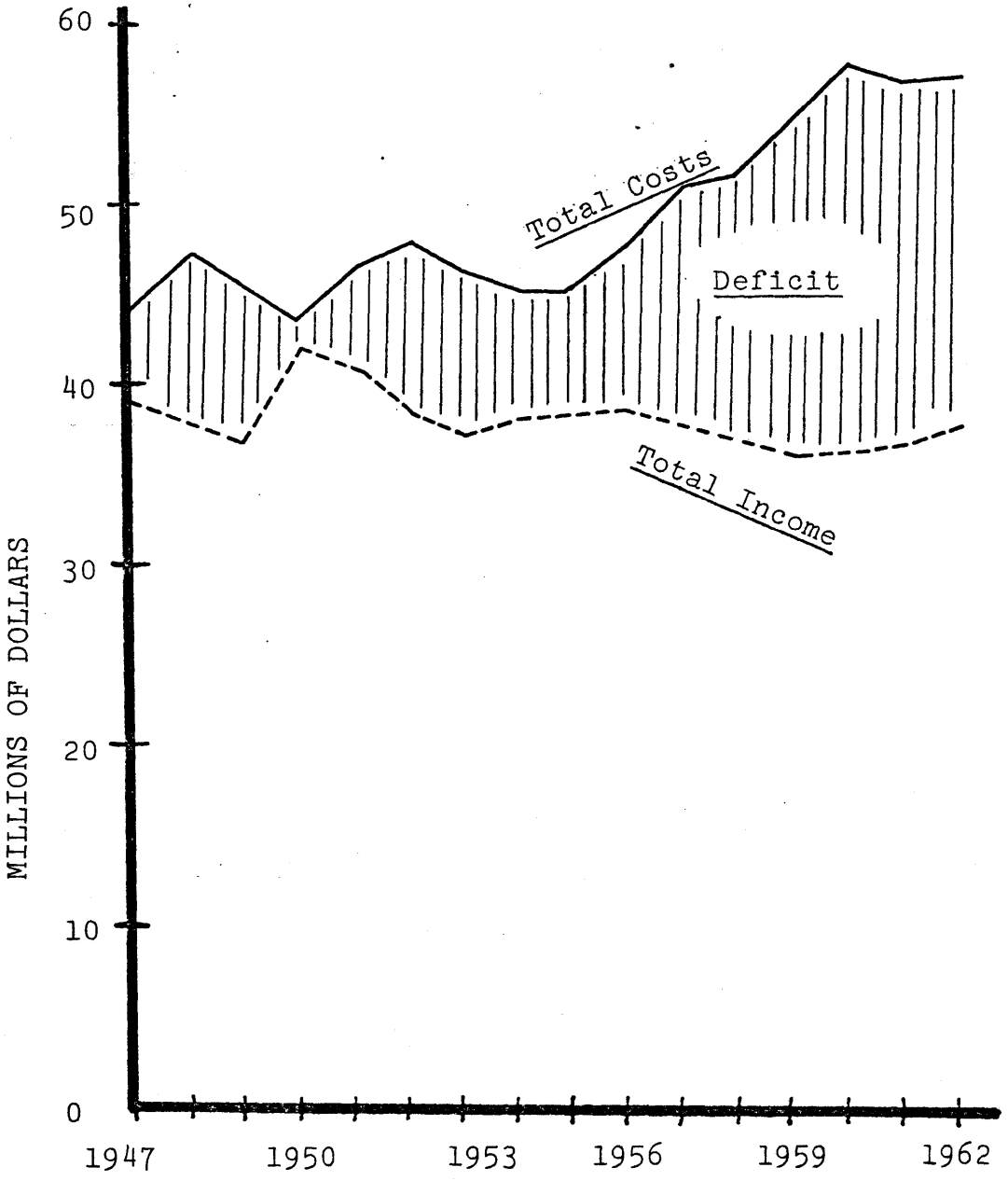
tripled. (See figure 2.) The member communities of the MTA were legally responsible to cover any losses incurred by the MTA's operation. The deficit was apportioned among the fourteen communities on the basis of a 1940 origin and destination survey of trips made by MTA riders. This formula of apportionment, in effect in 1962, remained unchanged throughout the entire seventeen-year history of the MTA.

Direct Benefits

In 1962, 271 million trips were made within the MTA system. The direct benefit of the public subsidy to MTA is the difference between the cost of providing an individual rider with transport service and the amount he pays in fare for that service. Using this definition, the total subsidy is allocated to individual beneficiaries by income class on the basis of the number and type of trips taken on MTA vehicles.

Direct Costs

In 1962 the 16.4 million dollar deficit of the MTA system was apportioned among the fourteen member communities. The direct costs of the subsidy to MTA are the taxes collected for the purpose of financing that subsidy. The allocation of these direct costs among the various income groups is the incidence of the local taxes levied to subsidize the MTA.



Source: M.T.A. Annual Reports

THE INCREASING GAP: INCOME MINUS COSTS

Figure 2

Chapter 3: Distribution of Direct Benefits

Definition

The direct benefits generated by the MTA were the provision of transport service, that is the movement of a passenger, say, from Park Street station to Harvard Square. These benefits accrue to the individual rider and are proportional to his use of the system. The cost of providing the service is met in two ways: fare collection and local taxation to pay the deficit.

The individual user pays for part of his ride through fares; if the cost of his ride exceeds the fare he has paid, the rider receives a fraction of the public subsidy to the MTA. Thus, the direct benefit of the subsidy is the difference between the cost of providing an individual rider with transport service and the amount he pays in fare for that service. Using this definition of the direct benefits of subsidy, it is possible to determine the beneficiaries of public subsidy without attempting the herculean task of estimating all the direct and indirect benefits of a transit ride.

An individual making a transit trip judges, at least implicitly, that the benefits of the trip are, at a minimum, equal to the amount of the fare. That individual might not agree, however, that the trip is worth the full-cost of providing it. Essentially he would be arguing that the portion of the trip cost above the fare does not measure any benefit he receives and therefore is not a valid measure of subsidy to him. In spite of the user's protestations to the contrary, the difference between the full cost of service and

the fare that users pay does measure the cost borne by someone else for the service the user receives and is, in an objective sense, a subsidy to him.

Methodology

Using the above definition of the direct beneficiary of subsidy the procedure for estimating the distribution of such benefits among income groups is fairly straight forward, albeit imprecise and difficult. Ideally, the procedure would involve the description of each of the 271 million passenger trips in 1962 on the basis of annual income of the passenger, the fare paid for the trip, and the full-cost of the trip. With this information it would be possible to estimate the share of the annual subsidy going to each of the respective income groups.

The problems associated with this procedure are mostly ones of data acquisition. Determining the full-cost of a transit trip does present some conceptual difficulties.

Data Base of Study

The data used in this study to characterize the users of the MTA system and to categorize the trips they made was collected in 1963 as a part of the Eastern Massachusetts Regional Planning Project (EMRPP). (The project was then known as the Boston Regional Planning Project.) The pertinent information about transit users and trips was gathered through a dwelling-unit survey conducted on a three-per cent sample of households in the MTA district.

This EMRPP survey recorded the residence, age, and annual family income of transit trip-makers. The transit trips were described by type of vehicle, by origin and destination, by time of day, by day of week, and by trip length in minutes. This information on about 14,500 MTA transit trips was placed on computer tape. The data in this form was manipulated for this study by means of a simple, computer language, 'EFFECT', specifically designed for handling large files of data. (For a more complete description of the computer records, data files, and 'EFFECT' language see Appendix A, Part I.)

The 14,500 transit trips described in the EMRPP survey were used as a sample of the 271 million MTA trips made in 1962. Although the sample is a very small portion of the total, it is sufficiently large to justify its use as representative of all trips. From a statistical viewpoint, the absolute size of a sample is more important in determining the sample's validity than is its proportionality.[1] (The application of the EMRPP dwelling-unit survey to this study and tests of the survey's accuracy are examined in Appendix A, Part II.)

For the purposes of this study the description of a transit trip must be compatible with the basis or formula for estimating the full cost of that trip in order that the amount of subsidy for each trip can be calculated. Consequently, the information obtained in the dwelling-unit survey constrains the categorization of transit trips and thereby also constrains the model for estimating costs.

Cost Formula

The task of allocating MTA's total expenses for 1962 over the 27¼ million transit trips is laden with pitfalls and passes over many difficulties and disagreements still unresolved among economic analysts who are clearly more knowledgeable on this subject than the author. For example, the problems of allocating a share of general administrative costs to any route or a particular run or the exact determination of the marginal costs of adding or deleting certain services defy the application of any commonly-accepted formula. Part of the difficulty lies with the unavailability of necessary record keeping. Most transit financial records are designed by accountants for their own purposes, not for use in economic analysis. In other instances certain costs such as taxes or administrative expenses are essentially non-traceable. That is, they cannot be divided among the various operations in anything but an arbitrary manner.[2]

Yet, despite these uncertainities in transit cost estimating, the intent of this study can be satisfied by relying on broader, more commonly-accepted cost concepts.[3]

A general form of the transit cost model is:

$$\text{Cost} = A(\text{operating characteristics}) + B(\text{capacity characteristics})$$

In this form "A" and "B" represent calculated unit costs. The operation characteristic is usually either vehicle miles or vehicle hours. Regardless of the choice, it is intended to measure the aspect of cost which would change with service

characteristics such as size of service area or congestion.

The capacity characteristic, usually designated as either number of passengers or vehicles, is intended to measure costs associated with operating a system of a particular size. Several examples illustrate such costs. Wages for vehicle personnel can be fairly rigid and do not necessarily vary directly with vehicle miles or even vehicle hours for that matter. The costs of terminal and maintenance facilities are also more closely associated with capacity than operational characteristics.

It should be noted that the differences between operational costs and capacity costs are not always distinct and discernible; there are "gray areas" between the two that are mutually inclusive. Economists and transport analysts would certainly argue and disagree over the exact break-down of a transit firm's costs on this basis.

Using the information in the data base the general cost model is applied to this study. The first constraint on this application limits separate treatment of each transit vehicle type. Information on the transit trips are reported as two combined groups: (1) motor buses and trolley buses, and (2) subway cars and streetcars. Accordingly, there are two cost formulas, one for each group.

$$\text{Bus} \qquad \text{Cost}_1 = A_1(\text{operation}) + B_1(\text{capacity})$$

$$\text{Subway} \qquad \text{Cost}_2 = A_2(\text{operation}) + B_2(\text{capacity})$$

Combining the four vehicle types into only two cost estimates introduces some inaccuracy since their cost

characteristics are obviously not identical. There is some evidence suggesting that this particular grouping minimizes any inaccuracies. In 1962 the MTA reported unit costs per revenue mile for each vehicle as:[4]

motor bus	$1.20
trolley bus	$1.39
streetcar	$1.90
subway	$2.00

In addition, the operating characteristics of the vehicles reinforce this pairing.

The capacity characteristic in the cost formula for this study is the annual number of trips on each vehicle grouping. The reason for selecting this parameter should be obvious. Each trip made on the MTA system will be recorded as a revenue passenger. Thus, revenue passengers and total trips are identical measures of capacity.

The choice of an appropriate parameter for the operating characteristic was more troublesome. Initially, an attempt was made to cost transit trips on the basis of miles traveled. Using the origin/destination information an approximate mileage chart was drawn. After several computer runs and further consideration, this parameter was discarded in favor of another.

The parameter finally selected as a measure of variation in operating costs was a unit of travel time, "trip-unit". A trip-unit is operationally defined as six minutes of travel on a transit vehicle. For example, a bus trip that takes 18 minutes would be comprised of three trip-units.

This definition attempts to relate the cost of a trip to the cost per vehicle hour of providing transit service. The trip-unit, as defined, does not directly account for mileage costs. The justification for focusing on the time-related costs of vehicle operation is that such costs are normally two to three times as large as mileage costs.[5] Moreover, mileage costs are indirectly considered since time units of travel with given average vehicle speeds do include equivalent average mileage costs.

An aspect of estimating transit costs that deserves special attention is the expensiveness of providing capacity for traffic that is heavy but of brief duration--namely the traffic during morning and evening rush hours. Peak-hour demands require extra equipment, extra servicing, and extra storage facilities. A case in point: The Pennsylvania Railroad in Philadelphia estimates that 80% of its commuter equipment was required for only 20 hours a week of peak demand.[6] Vehicle personnel for peak service usually must be employed on a full-time basis. In light of these conditions and with aggravated congestion costs it is reasonable to assume that a peak-hour trip generates more costs to the transit company than a similar trip during off-peak hours.

The cost formula constructed for this study does not take into account the differential costs of peak and off-peak service. Peak/off-peak effects were ignored because of evidence suggesting that the study's results would not be significantly affected. Since the study focuses on the service

variations among income groups, each income group's share of peak and off-peak travel was examined and is shown in Table 3.1.

Table 3.1
TRAVEL DURING PEAK AND OFF-PEAK HOURS[1]

Income Group	Per Cent of Transit Trips			
	Subway		Buses	
	Peak	Off-Peak	Peak	Off-Peak
Under - $ 3,999	12%	17%	15%	19%
4,000 - 4,999	10	12	12	14
5,000 - 5,999	16	16	16	16
6,000 -- 6,999	13	14	14	14
7,000 - 7,999	11	10	11	10
8,000 - 9,999	13	11	13	12
10,000 - 14,999	16	13	14	11
15,000 - Over	9	7	5	4
Total	100%	100%	100%	100%

[1]Peak hours are 7:30-9:30am/3:30-5:30pm Monday through Friday.

Source: EMRPP Dwelling-Unit Survey

As might be expected, higher income riders constitute a larger share of peak-hour travel than off-peak travel. Conversely, the lower income riders have a larger share of the off-peak travel than the peak-hour travel. While there are differences among poorer and richer riders, the differences are not substantial. Consequently, the cost formula does not need to have the sophistication necessary to property treat such small differences. It should be noted, however, that

ignoring peak/off-peak effects does introduce a slight bias that favors higher income riders.

The full-cost of a transit ride is estimated by the cost formula on the basis of which vehicle was ridden, the annual number of rides, and the length of each ride.

$$\text{Cost}_n = A_n(\text{trip-units}) + B_n(\text{trips})$$

In 1962 the MTA reported total cost of $57.0 million--$34.1 million for subway and streetcar operations and $22.9 million for buses.[7] (These figures represent out-of-pocket expenses and do not, therefore, include any depreciation allowances.) In calculating unit costs for "A" (trip-units) and "B" (trips) judgement is necessary to decide which MTA expenses should be allocated to each respective category. In order to test how this allocation affects the results a check was made by making two extreme assumptions which mark off the boundary of possible costing alternatives. In assumption one, called assumption A, all costs are allocated to trip-units, that is the variable costs of operation. In assumption two, assumption B, all costs are allocated to the expenses associated with capacity--unit costs per trip.

Under assumption A the total subway costs of $34.1 million divided by the number of subway trip-units estimated from the EMRPP survey averages out to 6 cents per trip-unit. The costs of $22.9 million divided by bus trip-units average 5 cents per trip unit.

bus trip cost = ($.048) x (no. of trip-units)
subway trip cost = ($.055) x (no. of trip-units)

Under assumption B, the total costs for bus and subway divided by the number of annual trips[8] average out to 17 cents per trip and 25 cents per trip, respectively.

bus trip cost = ($.172) x (1 trip)

subway trip cost = ($.246) x (1 trip)

Since fares were set at a flat rate in 1962 it is possible to calculate the distribution of the total subsidy, $16.4 million, between bus operations and subway and streetcar operations. Each of the 132,700,000 bus rides averaged 7.2 cents more in costs than was collected in fares--10 cents per ride. From these figures, the bus deficit is estimated at $9.5 million. The remaining $6.8 million deficit is attributed to subway and streetcar operations. This approach for allocating the total subsidy was made necessary by the fact that the subway and streetcar fares were mixed, with some at 10 cents and others at 20 cents.

The direct benefits of the subsidy have been defined as the difference between the cost of a transit trip and the fare paid for that trip. With assumption A, the distribution of the direct benefits of subsidy to bus and subway operations among the several income groups will be proportional to the number of trip-units they traveled. On the other hand, the distribution with assumption B is proportional to the number of trips.

Table 3.2 compares the distribution of trips and trip-units for buses and subways among the several income groups. There is only slight variation and no significant difference

Table 3.2
DISTRIBUTION OF MTA TRIPS AND TRIP-UNITS AMONG INCOME GROUPS

Income Group	(Ass. A) Subway Trip-units	(Ass. B) Subway Trips	(Ass. A) Bus Trip-units	(Ass. B) Bus Trips
Under - $ 3,999	11%	11%	16%	15%
4,000 - 4,999	7	8	9	9
5,000 - 5,999	12	11	13	13
6,000 - 6,999	13	13	13	14
7,000 - 7,999	11	11	12	12
8,000 - 9,999	16	16	15	15
10,000 - 14,999	19	20	16	16
15,000 - Over	11	10	6	6
Total	100%	100%	100%	100%

Source: EMRPP Dwelling-Unit Survey

between the two alternate measures of transit usage. This test, then, indicates that allocation of particular expenses between capacity costs (trips) and operating costs (trip-units) will not affect the results of the study. Therefore, estimates of trip cost will be based on assumption A. (It should be noted that in all instances the distribution of the direct benefits of the subsidy are treated separately for bus service and subway service. In most cases only the sum of the two is shown.)

Assumptions A and B both have implicit consequences concerning the MTA fare structure. Assumption B is equivalent to saying that all transit trips have the same cost regardless of length. Furthermore, the flat-fare system is 'fair' since under these conditions each transit ride is equally subsidized.

Assumption A states that the cost of a transit trip varies in direct proportion with the length of the ride. If this is so, the fare system needs to graduated on the basis of trip distance if each rider is to receive the same amount of subsidy per trip.

In general, it is thought that the flat-fare system (assumption B) is detrimental to lower-income transit riders. Given the residential location and employment centers of most poor in urban areas it would seem that they use transit for shorter trips thereby subsidizing the longer transit trips of higher income groups from the suburbs. If these conditions existed in Boston in 1962, assumption A in Table 3.2 should show the lower income group's use of transit as measured by share of total trip-units to be significantly less than their

share of trips.

Contrary to this general belief, the information contained in Table 3.2 suggests that the fare structure does not have much potential as a policy option capable of altering the distribution of MTA subsidy benefits among various income groups. It seems that the proportion of short, medium, and long transit trips is about the same for each income group. Thus, a graduated or zone fare structure would leave some riders in each income group 'better-off' and some 'worse-off'. From the standpoint of the individual rider, making users of long trips pay more would seem to be more 'fair', but would have little affect on the per cent of public assistance going to any single income group.

Benefit to the Various Groups

Using the methodology outlined, this study estimates the share of subsidy benefits received by various groups within the Boston metropolitan area as determined by income, age, and residential location. The direct benefit of the subsidy to MTA accrues to individuals and groups in proportion to their use of MTA services.

As with other municipal services, publicly-aided transit service is used by persons not directly assessed to pay the subsidy bill. In 1962 only the fourteen member communities of the MTA were burdened with the deficit of 16.4 million dollars. Table 3.3 shows the approximate value and per centage of transit subsidy received by persons residing outside the MTA district.

Table 3.3
EXPORTING OF TRANSIT SUBSIDY

	Transit Service Received	
	Per Cent	Value
MTA Residents	92%	$15.1 Million
Residents Outside MTA	8	1.3 Million
Total	100%	$16.4 Million

Source: EMRPP Dwelling-Unit Survey

Conclusions drawn from Table 3.3 need to be qualified in several respects. First, while service is exported beyond the MTA district boundaries, it must be remembered that municipal taxes are also exported to some extent. (The exporting of taxes which support the MTA will be examined in detail in the following chapter.)

Second, the transit boundaries effective in this study (1962) have been superceded by a reorganized transit authority that encompasses many more neighboring communities. As a result, what appears to be inadequate basis for financing public subsidy of transit has been improved, at least to some degree.

There is an aspect of the "export-problem", though, that bears heavily on the issue of distribution of benefits among income groups. In this case in particular the recipients of the exported service have significantly higher incomes, on the average, than the MTA residents.

Table 3.4 shows that the users of the MTA not residing in the MTA District, are closely grouped at the high end of the

Table 3.4
INCOME CHARACTERISTICS OF EXPORTERS[1]
OF MTA SERVICE

Income Groups	Per Cent of Total Exported Transit Service
Under - $ 3,999	4%
4,000 - 4,999	5
5,000 - 5,999	7
6,000 - 6,999	11
7,000 - 7,999	12
8,000 - 9,999	19
10,000 - 14,999	27
15,000 - Over	15
Total	100%

[1] MTA Users not residing in MTA district

Source: EMRPP Dwelling-Unit Survey

income scale. (Compare with distribution of trip-units in Table 3.2.)

The exported transit service consists almost entirely of subway rides. This is not surprising since the MTA buses provide mainly a feeder service located completely within the MTA district. In addition, the subway system is the primary transit service in the Boston central business district which has a high concentration of highly paid executives and professionals. Since many of these persons live in the out-lying suburbs their use of the subway for transport within the CBD is reported as exported transit service.

Use of the MTA transit systems by residents of the district is more evenly distributed among the various income groups. The information presented in Table 3.5 clearly shows that no single income group is the primary beneficiary of the public

Table 3.5

DISTRIBUTION OF MTA HOUSEHOLDS AND SUBSIDY BENEFITS

Income Group	Per Cent of Bus Benefits	Per Cent of Subway Benefits	Total Benefits	Per Cent of MTA Households
Under - $ 3,999	16%	11%	15%	22%
4,000 - 4,999	9	7	9	9
5,000 - 5,999	13	12	12	12
6,000 - 6,999	13	13	13	12
7,000 - 7,999	12	11	11	10
8,000 - 9,999	15	16	15	13
10,000 - 14,999	16	19	17	14
15,000 - Over	6	11	8	8
Total	100%	100%	100%	100%

Source: EMRPP Dwelling-Unit Survey; 1960 Census of Population

policy to subsidize the MTA. The only group whose share of subsidy is smaller than their share of the household units is the lowest income group--those under $4,000 annual income. The households that seem to be getting the most subsidy relative to the other groups are those with incomes of $10,000 to $15,000 yearly. (It is important to note that these trends evident in Table 3.5 do not include any of the exported subsidy.)

Table 3.5 seems to present a paradox. The groups receiving the largest relative share of public transit subsidies are the same groups which are least dependent upon public transit for their mobility when measured by number of licensed drivers, number of automobiles owned, and per cent of total trips by transit.[9] (The lowest income groups, however, do rely on private motor vehicles for transport more than is commonly believed.[10]) An explanation of this situation is that higher income households average the most total trips per day and as a consequence, they account for a share of automobile and transit trips larger than their share of the population.[11].

The information in Table 3.5 on types of MTA service reveals differential patterns of use by level of income.

The lower-income groups derive the largest share of their benefits from the subsidy to bus service. Those with incomes between $5,000 and $10,000 use the buses and subways approximately in the same proportions. The highest income group secure relatively larger benefits from subway trips.

These characteristics of service utilization have several possible explanations. They might reflect the proximity of

each type of MTA service to the residential and employment locations of the respective income groups. On the other hand, the rich might use the buses less because they have automobiles to take them to subway stations, while the poor rely more heavily on the buses for feeder service. In any case, the information in Table 3.5 suggests that improving either the bus or subway service could have a disproportionate impact, albeit limited, on either the lower or higher income groups.

For several reasons, special fare reduction programs are often advocated on behalf of the young and old. In 1962 children ages 5 through 14 rode the subways for half price. Since then, reduced fares have been offered to the elderly. Presumably the concessions are made to the young because their alternate transport options are limited and also because their school trips are of such social value to deserve special treatment. The elderly, likewise, normally have restricted mobility. In addition, the aged are generally believed, and probably correctly so, to be in need of public assistance to supplement their incomes which are usually fixed and small.

The young and elderly receive less of the MTA subsidy relative to their share of the population than does the large middle group. The dominance by the middle group should be expected because they generate the transit work trips which make up a large proportion of all transit trips.

The estimates in Table 3.6 show the youngest group's share of subsidy benefits as 15 per cent of the total. The young's share of total trip-units was actually only 11 per cent.

Table 3.6
DISTRIBUTION OF MTA SUBSIDY
BENEFITS BY AGE

Age Group	Per Cent of Subsidy Benefits	Per Cent of MTA Population Age 5 and Over
5 - 14	15%	21%
15 - 59	72	62
60 - Over	13	17
Total	100%	100%

Source: EMRPP Dwelling-Unit Survey

The four per cent difference is accounted for by the fact that on each subway ride they took, the young received an extra 10 cent subsidy through reduced fares. In effect, the young's share of subsidy benefits is greater than their proportion of total transit usage. (In 1962 the elderly did not benefit from a reduced fare program.) If the young would have been charged full fare on all trips, the breakdown of subsidy shares for the young, middle, and elderly groups would have been 11%, 75%, and 14% respectively. Consequently, the reduced fare program increases the young's subsidy by about one-half of a million dollars.

The young beneficiaries of the subsidy increase are those coming from the families with higher annual incomes. For example, children from families having less than 4,000 dollars annual income would have received subsidized transit service valued at $199,000, without reduced fares; with reduced fares it would have increased by $42,000 to $241,000. Children from

families with annual incomes between $8,000-$10,000 increased the value of their subsidized transit service $105,000 (from $327,000 to $432,000) through fare reductions on rapid transit trips. This effect of reduced children's fares is mainly attributable to the fact that it was applied only to subway trips. As earlier tables suggested, the poor benefit more from bus service than subway service, which for the richer the opposite is true. Reduced fares for children on buses would benefit the poorest riders the most.

Table 3.7
DISTRIBUTION OF SUBSIDY BENEFITS TO YOUNG AND ELDERLY

Income Group	Per Cent of Total Subsidy to Young[1]	Per Cent of Total Subsidy to Elderly[2]
Under - $ 3,999	10%	32%
4,000 - 4,999	8	10
5,000 - 5,999	14	11
6,000 - 6,999	16	11
7,000 - 7,999	14	8
8,000 - 9,999	16	8
10,000 - 14,999	15	12
15,000 - Over	7	8
Total	100%	100%

[1]Ages 5 through 14
[2]Ages 60 and over

Source: EMRPP Dwelling-Unit Survey

Table 3.7 gives a more complete picture of the distribution of subsidy to the young and elderly by income group. It is clear that the subsidy going to young riders benefited those

from families with incomes in the middle and upper ranges. This profile results from patterns of usage among income groups and the type of reduced children's fare in effect.

The elderly group beneficiaries offer a marked contrast to the young ones. The poorest are receiving a share of the subsidy several times that of any other group. Consequently it is likely that reduced fares for the elderly which have been instituted since 1962 have increased the share of MTA subsidy going to the lowest income group. Table 3.7 suggests that increases of subsidy to the elderly have been more beneficial to the poor than similar increases to the young.

The distribution of the direct benefits of subsidy among MTA's member communities is at the heart of much controversy and political debate which surround the subsidy issue. MTA's deficit was apportioned among the fourteen communities.on the basis of a 1947 origin/destruction study. Each community was charged a share of the deficit roughly proportionate to the share of trips originating within its boundaries. Many communities felt that the apportionment formula was outdated and resulted in an inequitable distribution of costs among the cities and towns for 1962. The amount shown for each community represents the total subsidy received by residents of that community regardless of where the trip was made. For example, if a resident of Newton rode a bus from Cambridge to Boston the subsidy of that trip is attributed to Newton. Essentially, this method of accounting argues that the benefit of the subsidy accrues to the community in which the transit user resides,

not to the community through which the transit vehicle passes.

The residents of Boston, who use the MTA, receive over half of the total MTA subsidy. On the other hand Belmont and Watertown receive only about 1 per cent. This wide variation reflects the extent to which Boston through its population and their use of transit service dominate the MTA. The household figures suggest how much each of the communities relys on the MTA for passenger transport. Obviously the residents of Chelsea, Arlington, and Boston were using the MTA much more than the residents of Watertown, Belmont, and Newton.

Table 3.8
DISTRIBUTION OF SUBSIDY BENEFITS AMONG
MTA'S MEMBER COMMUNITIES

Community	Per Cent of Subsidy	Value of Subsidized Transit Service	Value of Subsidy Per Household
Boston	52%	$ 8,616,000	$35
Cambridge	7	1,085,000	28
Somerville	6	981,000	33
Medford	4	717,000	37
Arlington	4	579,000	41
Chelsea	3	467,000	42
Brookline	3	454,000	22
Malden	3	459,000	27
Newton	3	429,000	18
Everett	2	394,000	30
Revere	2	384,000	30
Milton	1	195,000	18
Belmont	1	166,000	20
Watertown	1	148,000	10
Exported	8	1,331,000	
Total	100%	$16,405,000	

Source: EMRPP Dwelling-Unit Survey; 1960 Census of Population

Table 3.8 is of little value in evaluating the MTA deficit apportionment formula until it is compared with a distribution of subsidy costs. This compariosn will be made in a later chapter. All table 3.8 really shows is the patterns of use of MTA by the residents of the MTA member communities.

Summary

The information presented in this chapter has shown that the beneficiaries of the MTA subsidy are of all ages, income groups, and residences. About 8 per cent of the MTA subsidy is received by persons not living in the MTA district. Most of the users of MTA service who live outside the MTA district have higher than average incomes. Within the MTA there is wide variation in the amount of transit service received by the member communities. Of the subsidies going to the elderly, the largest shares accrue to those from the lowest income group. Among the young transit users, the higher income groups reap the most benefits of public subsidy. In general, the buses are used more by lower income groups, and the subways by higher income groups.

Table 3.9 presents an overall picture of how well households in various income groups fared in securing transit subsidies in 1962. It is important to note that household figures are averages. Most likely those households in each group which used the MTA regularly received subsidized service equal to several times the values listed above.

Table 3.9
DISTRIBUTION OF SUBSIDY BENEFITS
PER HOUSEHOLD

Income Group	Value of Subsidized Service Received	Number of MTA Household Units	Subsidy Per Household
Under - $ 3,999	$ 2,245,000	100,500	$22
4,000 - 4,999	1,312,000	41,100	32
5,000 - 5,999	1,904,000	54,900	35
6,000 - 6,999	1,987,000	54,700	36
7,000 - 7,999	1,717,000	45,700	38
8,000 - 9,999	2,213,000	59,400	37
10,000 - 14,999	2,566,000	63,900	40
15,000 - Over	1,131,000	36,500	31
Total	$15,074,000	456,700	

Source: EMRPP Dwelling-Unit Survey; 1960 Census of Population

The variation in the household figures is significant. In the $10-15,000 range the households averaged almost twice as much subsidy as the poorest group. All other income groups received a subsidy at least fifty per cent greater than the households with annual incomes under $4,000. Although the net effect of the subsidy cannot be assessed until the costs of the subsidy are considered, it is obvious that the MTA subsidy program does not function mainly for the purpose of assisting the poorest of the Boston metropolitan area in meeting their transport needs.

Chapter 4: The Incidence of Taxes Subsidizing MTA

Introduction

The previous chapter examined the distribution of the direct benefits of the MTA subsidy. This chapter studies the other side of that coin--the distribution of the direct costs of the subsidy. The direct costs are the taxes collected for the purpose of financing that subsidy.

As explained in Chapter 2 the annual operating deficit of the MTA, called the net cost of service, becomes the financial obligation of the fourteen member communities. Each of these communities pays its share of the deficit from its general revenue fund. The task of this chapter, then, is to determine the incidence of those taxes which generate that revenue.

Dividing the cost of a governmental program among the household units within particular political boundaries is a vexatious and imprecise endeavor. The primary difficulty arises in determining which taxes are collected for what purposes. In general the process of collecting taxes does not include any specification of the use to which they will be put. In this study that is the situation since the MTA cities and towns do not collect any revenue specified as "MTA taxes". In the absence of this information the best that can be done is to look at the unspecified funds (i.e. general revenue fund) available to the municipal governments of the MTA member communities.

Cities' general revenue money either comes from its own sources or from other governmental units, usually state and federal. In 1962 neither the state nor the federal government

were providing local government with revenue to subsidize mass transportation. Thus, it is safe to assume that the MTA subsidy was coming from the general revenue funds raised from the cities' own sources. Examination of this financial category reveals the local property tax as the most likely source of MTA subsidy. Table 4.1 shows how dependent a sample of the

Table 4.1
GENERAL REVENUE SOURCES OF
SEVEN MTA COMMUNITIES

Community	Per Cent Property Tax Revenue of General Revenue
Boston	89%
Brookline	85
Cambridge	91
Malden	90
Medford	90
Newton	91
Somerville	93

Source: Bureau of the Census, City Government Finances in 1962

MTA communities were on property tax for general revenue in 1962.[1] (These seven cities and towns pay 90 percent of the MTA deficit.) The situation in the other seven communities was generally the same.

Methodology

In estimating the incidence of local property taxes several methodological difficulties must be overcome. The first is the exporting of property taxes, especially those

on commerical and industrial properties. Goods and services purchased by a non-resident of the MTA will carry with them a fraction of the property tax--that is, part of the property tax will be exported. It will be necessary to determine export rates in order to allocate the direct costs of MTA subsidy borne by residents of the MTA district.

The second problem focuses on making reasonable assessments concerning the "shifting" of the property tax. For example, property taxes levied on a clothing store are passed on to the persons purchasing clothing, i.e. shifted to consumers. The exporting and shifting of property taxes on the various types of assessed property will be dealt with as they become applicable.

The initial step in the incidence study was the categorization of total assessed property valuation in each of the fourteen MTA communities into five groups--residential (single-family), residential (multi-family), commercial, manufacturing, and other. The property taxes levied on each of these land-use types was then distributed among the households in each of the various income groups. Finally, summing the tax components then gave the distribution of the direct costs of the MTA subsidy by income.

Burden of MTA Subsidy on Local Property Taxes

In 1962 the MTA subsidy of $16.4 million was apportioned among the fourteen member communities. Table 4.2 gives the distribution of the direct cost of the subsidy by community.

Table 4.2
DISTRIBUTION OF DIRECT SUBSIDY COST
AMONG MTA COMMUNITIES

Community	Direct Costs Financed By Property Taxes	Per Cent of Direct Costs
Boston	$10,562,000	64%
Cambridge	1,363,000	8
Somerville	821,000	5
Brookline	641,000	4
Malden	533,000	3
Medford	527,000	3
Everett	382,000	2
Chelsea	331,000	2
Arlington	309,000	2
Revere	268,000	1
Watertown	212,000	1
Belmont	179,000	1
Newton	130,000	1
Milton	127,000	1
Total	$16,405,000	100%

Source: Massachusetts, State Auditor Report on MTA Accounts

When viewing Table 4.2 it is important to keep in mind that not all the deficit assessed to a city or town is actually paid by the residents of that community. For example, Boston is assessed over three-fifths of the total deficit, but a significant portion of Boston's property tax is exported via commercial and manufacturing sales. In any case, Boston dominates the distribution of direct costs just as it did the distribution of direct benefits of subsidy. In order to evaluate the "fairness" of the deficit apportionment formula vis-a-vis the distribution of benefits, the two will be compared more closely in the following chapter.

In order to determine the incidence of those property taxes subsidizing the MTA it is necessary to know the breakdown of total assessed property valuation for each city and town. Table B.1 in appendix B gives the distribution of assessed valuation by town. By combining the information in Tables 4.2 and B.1 it is possible to arrive at a distribution of the taxes supporting MTA by land use type. This distribution is shown below in Table 4.3.

Table 4.3
INCIDENCE OF PROPERTY TAXES SUPPORTING MTA BY LAND USE TYPE

Land Use	1962 Tax Payments to Subsidize MTA	Per Cent
Residential (single-family)	$ 3,730,000	23%
Residential (Multi-family)	4,429,000	27%
Commercial	4,739,000	29%
Manufacturing	2,383,000	14%
Other	1,070,000	7%
Total	$16,405,000	100%

Source: Table 4.2; Table B.1

Table 4.3 results from totaling the tax distribution by land use type for each MTA community. For example, in 1962 23 percent of the total cost of the MTA subsidy was collected from owners of single-family residences in the MTA district. The "other" category is a grouping of miscellaneous valuations listed in each town such as vacant land and public utilities. Since in many instances public utilities were the largest

single component of the "other" category and lacking any better alternatives, all the taxes in this miscellaneous grouping were treated and distributed as taxes on public utilities. It is impossible to assess the error resulting from this assumption; solace is taken from the fact that no more than one-twentieth of the total MTA deficit could be affected by this handling of the miscellaneous properties.

Distribution of Residential Taxes

The residential taxes are divided into two categories--single-family and multi-family dwellings. It is assumed that all single-family dwellings are owner-occupied, and that all multi-family dwellings are renter-occupied.

In order to calculate the distribuiton of residential taxes the shifting and exporting of taxes must be considered. Several assumptions are made:

1) The taxes on owner-occupied residences are paid by the owner. It is fairly obvious that a home-owner is unable to shift his property taxes to another party.

2) The taxes on renter-occupied residences are paid by the renter--that is, all taxes are shifted to the renter. The prime determinant of whether or not taxes will be shifted is the extent to which the tax is common to all similar property.[2] Since property taxes are levied against all apartment buildings, the apartment owners can treat the tax as a cost and pass it on to the renter.

3) A fraction of local property taxes can be exported

to the federal government through deductions allowed in federal income tax statutes.[3] For example, if a family in a 15 percent federal income tax bracket pays one dollar in property tax his federal taxes are reduced by 15 cents, so that the net property tax burden is only 85 cents. Homeowners and renters benefit alike from such exporting, since property taxes are deductible for landlords.

These assumptions, which are reasonable in view of economic theory, are common to tax incidence studies.[4]

The property taxes on single-family residences are assumed to be proportional to the value of the house. The basis for allocating the $3.7 million taxes on single-family homes was information contained in the U.S. Census of Housing on the value of housing by income groups.[5] Table 4.4 gives the results of that allocation.

Table 4.4
DISTRIBUTION OF PROPERTY TAXES ON SINGLE-FAMILY RESIDENCES BY INCOME

Income Group	Taxes Subsidizing MTA	Per Cent
Under - $ 3,999	$ 400,000	10%
4,000 - 4,999	186,000	5
5,000 - 5,999	359,000	10
6,000 - 6,999	394,000	10
7,000 - 7,999	366,000	10
8,000 - 8,999	581,000	16
10,000 - 14,999	783,000	21
15,000 - Over	661,000	18
Total	$3,730,000	100%

Source: 1960 Census of Housing

The property tax paid by renters was assumed to be proportioned to their gross rent given that rents in general reflect the value of the renter-occupied structure. The distribution of taxes on multi-family residences was calculated from census data giving gross rents by income group.[6] Table 4.5 shows that distribution among the various income groups.

Table 4.5
DISTRIBUTION OF PROPERTY TAXES ON MULTI-FAMILY RESIDENCES BY INCOME

Income Group	Taxes Subsidizing MTA	Per Cent
Under - $ 3,999	$1,416,000	33%
4,000 - 4,999	503,000	11
5,000 - 5,999	558,000	13
6,000 - 6,999	456,000	10
7,000 - 7,999	362,000	8
8,000 - 9,999	446,000	10
10,000 - 14,999	458,000	10
15,000 - Over	185,000	4
Total	$4,429,000	100%

Source: 1960 Census of Housing

Table 4.4 and 4.5 mirror the divergent patterns of owning and renting which exist among lower and higher income families. The poorest group pays one-third of the taxes on rental property; most of these taxes are collected in the city of Boston. Families with annual incomes in excess of $8,000 pay a quarter of multi-family taxes; the same group accounts for over a half of the taxes paid by homeowners. Thus, most renters come from the lower income groups and most homeowners from the high income groups.

A study[7] of assessment practices in the city of Boston by Oldman and Aaron suggests that Tables 4.4 and 4.5 underestimate the share of residential taxes paid by the lower income groups. Their study, which concentrates on 1962 data, is especially relevant to this tax incidence study because Boston taxes account for 65 percent of the total MTA subsidy. Oldman and Aaron found inequalities in the assessment--sales ratios among property types, among regions of the city, and among price classes. Single-family residences had assessment--sales ratios much lower than multi-family residences. West Roxbury, an area with high average incomes, had a assessment--sales ratio of 35 percent, while Roxbury, one of the most depressed areas of the city, had the city's highest ratio at 75 percent. The lowest priced properties had the highest average ratio for all properties (85 percent). In general, ratios were lower for higher-priced properties than for lower-priced properties. Thus, the assumption that property taxes are proportional to value of housing and gross rent levels is the source of bias existing in the two previous tables. No attempt was made to adjust the data in Tables 4.4 and 4.5 in view of these circumstances. The effect of this bias on the study's finding, however, is considered in the following chapter.

The net burden of local property taxes can be reduced by claiming deductions allowed under federal income tax statutes. To the extent that such deductions are claimed by the residents of the MTA district they are able to reduce the

portion of the MTA subsidy that they must pay. This opportunity to escape some of the MTA subsidy costs does not fall equally among all income groups. The higher income groups have an advantage since their rate of property tax savings is directly related to their marginal income tax rate. In a 1965 study[8], Melvin and Anne White estimated the average savings from such property tax deductions which accrue to taxpayers in the various income groups. (The White figures are national averages including both tenants and homeowners.) On the basis of the White study, Table 4.6 has been prepared to show the exporting of taxes that subsidize the MTA.

Table 4.6
DISTRIBUTION OF EXPORTED RESIDENTIAL TAXES

Income Group	Exported Residential Taxes	Exported Taxes as Per Cent of Total Residential Taxes
Under - $ 3,999	$ 12,000	-%
4,000 - 4,999	8,000	1
5,000 - 5,999	19,000	2
6,000 - 6,999	25,000	3
7,000 - 7,999	24,000	4
8,000 - 9,999	81,000	8
10,000 - 14,999	125,000	10
15,000 - Over	178,000	21
Total	$472,000	6%

Source: National Tax Journal

As Table 4.6 clearly shows the mesh of federal and local tax laws serves the wealthiest taxpayers in grand fashion. The

federal government, in effect, paid one-fifth of the residential taxes levied against the highest income group for the purpose of subsidizing the MTA. At the same time, the poorest taxpayers received essentially no federal relief from similar taxes. This type of tax exporting has a profound impact on the distribution of the direct costs of subsidy among the various income groups.

The overall picture of the incidence of residential taxes subsidizing the MTA is shown in Table 4.7. The regressivity of the property tax is clearly evident in the table below.

Table 4.7
INCIDENCE OF PROPERTY TAXES
ON RESIDENTIAL PROPERTY

Income Group	Residential Taxes Subsidizing MTA	Per Cent	Residential Taxes Per Household
Under - $ 3,999	$ 1,849,000	23%	$18
4,000 - 4,999	681,000	8	17
5,000 - 5,999	898,000	11	16
6,000 - 6,999	825,000	10	15
7,000 - 7,999	704,000	8	15
8,000 - 9,999	946,000	12	16
10,000 - 14,999	1,116,000	14	17
15,000 - Over	668,000	8	18
Exported -	472,000	6	18
Total	$ 8,159,000	100%	

Source: Table 4.4; Table 4.5; Table 4.6

The lowest income group pays as much as the highest income group in absolute terms. The symmetry of the household figures about the $7,000 annual income point is caused by the effect

of federal income tax deductions on the residential tax burden. Considering the possible understatement of the burden borne by lower income groups as revealed in the Oldman-Aaron study, Table 4.6, does raise serious questions about how equitably the residential portion of the costs of MTA subsidy are distributed.

Incidence of Non-Residential Property Taxes

About one-half of the 1962 MTA subsidy came from property taxes on non-residential property. These properties are divided into three categories--commercial; manufacturing; and other; with respective tax burdens of $4.8 million, $2.4 million, and $1.1 million. The incidence of these taxes is not easily determined because of the rather severe methodological and data-acquisition problems associated with tax shifting and exporting. The regional, and even national character, of many business activities in the Boston region exacerbates the problem of identifying and tracing the incidence of the property tax. These difficulties will be surmonted by making what seem to be reasonable assumptions in light of economic theory and prior empirical studies.

The assumptions regarding tax shifting are enumerated below.

1) The property taxes in the "other" category are treated as taxes on public utilities as explained earlier. All of these taxes are assumed to be paid by consumers which is consistent with legal precedent in rate making.[9]

2) Property taxes levied on commercial property are borne by consumers. This assumption is based on the fact that such taxes are common to all commercial property and can therefore be treated as a cost recovered through price increases.

3) Property taxes paid by manufacturing corporations are assumed to be evenly divided between corporate owners and consumers. This assumption is a compromise made necessary because of empirical and theortical ambiguities. Theortically it is possible that corporate taxes could be shifted either to the consumers through higher prices, or to the employees through lower salaries, or to the owners through lower profits. A study done by Rotchford and Hahn suggests that in most cases the consumers and corporate owners carry the burden of the taxes.[10]

The purchase of goods and services by persons not residing in the MTA district amounts to an export of a fraction of the property taxes. Several assumptions about such exporting are made.

1) The export rate for commercial property taxes is set at 23 percent. This rate was determined by comparing estimates of retail sales per capita of MTA residents to those of the residents of Massachusetts. For 1962, the Survey of Buying Power[11] estimated total retail sales per capita in Massachusetts at $1,370. Assuming that MTA residents made retail purchases at the same pace, the residents of MTA would have spent approximately $1,920 million on retail transactions.

Since MTA retail establishments reported[12] retail sales of $2,500 million during that period, it is assumed that $580 million (23%) of commercial business was exported.

Another assumption is that patterns of wholesale business do not differ significantly from their retail counterparts. Given the dominance of Boston in the New England Region, this assumption probably understates, somewhat, the taxes exported through wholesale business. Furthermore, the commercial export rate is, undoubtedly, a conservative estimate for several other reasons. First, it implies that the MTA residents made all their retail purchases within the MTA district--a highly unlikely circumstance. Second, the method used to estimate the export rate fails to consider adequately those property taxes exported by the nation-wide business activities of advertising agencies, law firms, and financial institutions. In addition, the incidence of property taxes levied against large corporate office buildings, such as those belonging to insurance companies, extends throughout the nation. Unfortunately, the methodology and data for such detailed considerations are not available.

2) The export rate for property taxes on manufacturing corporations is determined by looking at two separate cases: (a) those manufacturing taxes borne by national corporations with plants located in the MTA district; and (b) those taxes levied against local manufacturing firms. The consumers and corporate owners absorbing the taxes on the former group reside throughout the nation. The taxes on local firms operating

within the MTA district are assumed to be paid by the consumers and corporate owners living within the Boston SMSA. This latter restriction, although somewhat arbitrary, does not seem wholly unreasonable and does provide necessary data. It might be argued that the sales and ownership of local manufacturing firms encompasses all of Eastern Massachusetts. To this extent, setting the Boston SMSA as the local export boundary results in a conservative estimate of the export rate.

In order to allocate manufacturing taxes among various firms it is assumed that the value of a firm's physical plant, and thereby its assessed valuation and tax burden, is roughly proportional to the number of its employees. It seems likely that a plant with a thousand employees would have a higher valuation than one with ten employees. This yardstick is inexact, though, since the technology of various industries demands significantly different ratios of labor to equipment. Nevertheless, the employee criterion is used because of the paucity of data for other means of allocation.

The test for either national or local character of a particular manufacturing firm is simply whether or not its stock was listed on the New York or American Stock Exchanges in 1962.

According to the Massachusetts' Division of Employment Security, there were 153,000 employees[13] working in about 1,700 manufacturing firms[14] in the MTA district in 1962. Of these approximately 42,500 men (28 percent of the total) were employed in manufacturing plants owned by twenty-three national

corporations.[15] (Appendix C gives more detailed information.) Thus, the national export rate of MTA manufacturing taxes is assumed to be 28 per cent of the $2,383,000 total. These taxes are borne by the customers and owners of the national corporations.

The remaining 72 per cent ($1,716,000) is divided evenly among consumers (36%) and corporate owners (36%) within the Boston SMSA in accordance with the previous assumptions about tax shifting. The 1960 Census of Population[16] reports that a little over half (55%) of the Boston SMSA households were located within the MTA district. Since average income within the MTA district was slightly lower than income in the rest of the SMSA, it seems reasonable to assume that MTA households borne only about a half of the consumer portion of property taxes on local manufacturing firms.

Likewise, the corporate ownership share of property taxes on local manufacturing firms is allocated evenly between households in the MTA district and those in the remainder of the SMSA. The justification for this break-down is the distribution of the members of the highest income group ($15,000 and over) within the SMSA. The 1960 Census of Population[17] estimated that half of the SMSA families in this income category lived within the MTA district. This fact is significant since on the basis of dividend income as reported by the Bureau of Labor Statistics[18] the richest income group pays the largest share (75%) of property taxes borne by corporate owners.

3) The export rate of property taxes on public utilities

Table 4.8

EXPORTING AND SHIFTING OF NON-RESIDENTIAL PROPERTY TAXES

Group Paying Property Tax	Commercial Tax (%)	Manufacturing Tax (%)	Public Utilities Tax (%)	Total (%)
MTA Consumers	$3,691,000(77%)	$ 429,000(18%)	$1,070,000(100%)	$5,190,000(63%)
MTA Corporate Owners		429,000(18%)		429,000(5%)
Exported	1,102,000(23%)	1,525,000(64%)		2,627,000(32%)
Total	$4,793,000(100%)	$2,383,000(100%)	$1,070,000(100%)	$8,246,000(100%)

Sources: Massachusetts Division of Employment Security; 1960 Census of Population; Survey of Buying Power

is assumed to be zero. In an empirical study[19], C. E. McClure estimated the rate of export of property taxes via public utilities in Massachusetts to be zero. In the absence of any data challenging his findings, the same rate will be used in this study.

Table 4.8 on the previous page shows the incidence of non-residential property taxes among consumers and corporate owners. The consequences of the assumptions about shifting and exporting of property taxes appear more clearly. The consumers residing within the MTA district pay nearly three-fourths of property taxes on non-residential property. Since the assumed export rates were conservative the 70 per cent figure in Table 4.8 should be viewed as a maximum for that group. The corporate owners are burdened with only a slight fraction of total non-residential property taxes. The exported taxes are borne by consumers and corporate owners living beyond the boundaries of the MTA district; the estimate for exported taxes is most likely a minimum.

The $5.2 million in taxes paid by consumers is distributed among the MTA households on the basis of patterns of consumption as reported in the Survey of Consumer Expenditures[20] prepared by the Bureau of Labor Statistics. The incidence of taxes paid by corporate owners is determined on the basis of patterns of dividend income also reported by the Bureau of Labor Statistics[21]. Tables 4.9 and 4.10 show the distribution of these taxes among the several income groups.

Table 4.9
DISTRIBUTION OF PROPERTY TAXES
ON CONSUMPTION

Income Group	Taxes Subsidizing MTA	Per Cent
Under - $ 3,999	$ 417,000	9%
4,000 - 4,999	310,000	6
5,000 - 5,999	519,000	10
6,000 - 6,999	571,000	11
7,000 - 7,999	571,000	11
8,000 - 9,999	830,000	16
10,000 - 14,999	1,038,000	20
15,000 - Over	934,000	18
Total	$5,190,000	100%

Source: Bureau of Labor Statistics; Table 4.8

Table 4.10
DISTRIBUTION OF PROPERTY TAXES
ON DIVIDEND INCOME

Income Group	Taxes Subsidizing MTA	Per Cent
Under - $ 3,999	$ 13,000	3%
4,000 - 4,999	4,000	1
5,000 - 5,999	17,000	4
6,000 - 6,999	4,000	1
7,000 - 7,999	4,000	1
8,000 - 9,999	17,000	4
10,000 - 14,999	56,000	13
15,000 - Over	314,000	73
Total	$ 429,000	100%

Source: Bureau of Labor Statistics; Table 4.8

Taxes on consumption fall on all income groups as evidenced in Table 4.9. Although the higher income groups pay the larger amounts, the tax on consumption strikes the poorer taxpayer harder since it devours a larger proportion of their available income. Property taxes paid by corporate owners is incident on primarily one income group--the wealthiest one. Since the rich own most corporate stock almost all taxes not shifted are paid by them as shareholders. (The rather erratic pattern of corporate ownership in the lower income groups is probably explained by stock held by elderly households with shrinking income.) Table 4.9 shows a regressive incidence of the property tax while Table 4.10 reflects the opposite--a progressive incidence.

Incidence of Direct Costs of Subsidizing MTA

Combining the incidence of residential and non-residential property taxes reveals the overall picture of who pays for the MTA subsidy. Table 4.11 gives an approximate distribution of

Table 4.11
DISTRIBUTION OF DIRECT COSTS OF SUBSIDY
AMONG MTA RESIDENTS

Income Group	Property Taxes	Per Cent	Taxes Per MTA Household
Under - $ 3,999	$ 2,279,0002	14%	$23
4,000 - 4,999	1,995,000	6	24
5,000 - 5,999	1,434,000	9	26
6,000 - 6,999	1,400,000	8	25
7,000 - 7,999	1,279,000	8	27
8,000 - 9,999	1,793,000	11	30
10,000 - 14,999	2,210,000	13	35
15,000 - Over	1,916,000	12	52
Exported	3,099,000	19	
Total	$16,405,000	100%	

Source: Table 4.7; Table 4.9; Table 4.10

the direct costs of MTA subsidy in 1962. The percentage figures are less important in understanding the incidence of the MTA taxes than the household figures since the per cent break-down does not account for population differences among the groups. Although the lowest and highest income groups pay the same share of the cost of subsidy, the richest households contributed nearly three times as much in taxes to support MTA as the poorest ones.

In general, Table 4.11 suggests that taxes levied to subsidize MTA are regressive at the lower end of the income scale, roughly proportional in the middle range, and slightly progressive among higher income groups. These findings are consistent with similar studies of property tax incidence conducted by the Tax Foundation, Inc. of New York[22].

Reconsidering the methodological basis of this MTA study several qualifications about the data in Table 4.11 need to be emphasized. First, the review of assessment practices in Boston indicated an understatement of the residential taxes paid by the lower income groups. In view of this possible systematic bias the proportion of taxes reported as borne by the poor household is most likely a minimum relative to the other groups. Second, the use of conservative export rates suggests that, on the average, the taxes paid by MTA residents were probably less than shown in Table 4.11. Thus, in general, the tax amounts estimated per household are maximums.

Suppose in 1962 no property taxes were collected to subsidize the MTA. The residents of the MTA district would have

been richer by only $13.3 million, not by the $16.4 million amount of the MTA deficit. In 1962 the MTA residents imported some of the property tax of other communities as their's was exported. Such tax imports were ignored in this study because they bear no relation to the direct costs of the MTA subsidy.

When examining the effects of the policy of subsidizing MTA on income redistribution, the incidence of the exported taxes is also of interest. The distribution of all property taxes subsidizing MTA by income without regard to residence is shown in Table 4.12. The incidence of the exported taxes

Table 4.12
DISTRIBUTION OF DIRECT COSTS
OF MTA SUBSIDY

Income Group	Property Taxes	Per Cent
Under - $ 3,999	$ 2,628,000	16%
4,000 - 4,999	1,156,000	7
5,000 - 5,999	1,660,000	10
6,000 - 6,999	1,656,000	10
7,000 - 7,999	1,561,000	9
8,000 - 9,999	2,112,000	13
10,000 - 14,999	2,732,000	17
15,000 - Over	2,900,000	18
Total	$16,405,000	100%

Source: Tax Foundation, Inc.; Table 4.11

was estimated by looking at its various components separately: (1) The commercial and local manufacturing portions were allocated among the households within the Boston SMSA but outside the MTA district[23]. (2) The national manufacturing share was

distributed according to national patterns of consumption and dividend income.[24] (3) The residential taxes exported through income tax deductions were distributed on the basis of federal income tax incidence.[25]

Comparison of Tables 4.11 and 4.12 reveals that they are basically the same. In the latter table each income group's share of the tax burden has increased by several per cent, except the $10,000-15,000 and $15,000-plus groups. Their shares were greater by four and six per cent respectively. This is explained by the fact that most exported taxes were those levied on non-residential properties. The distribution of non-residential property taxes falls more heavily on the upper-income classes than do residential taxes.

The distribution of the direct costs of MTA subsidy determined in this chapter should be of special interest when compared to similar distributions of subsidy benefits. This comparison made in the next chapter should give some insight into which income group's interests are best served by public subsidy of MTA.

Chapter 5: Net Effects of MTA Subsidy

Comparing Direct Costs and Benefits

Knowing who rode the MTA gives information about who received the direct benefits of the public subsidy. Determining who paid the taxes that financed the subsidy tells the other half of the subsidy story. Comparison of the two, as shown in Tables 5.1 and 5.2 on the following pages reveals a more complete picture of the relative impacts of the MTA subsidy on the several income groups.

Table 5.1 focuses on the households within the MTA district while Table 5.2 is a more general accounting of net benefits by income group without regard to place of residence.

Several aspects of the findings in the first table stand out. Probably the most prominent is the extent to which people outside the MTA district support transit usage by MTA residents. Nearly a fifth of the taxes paid in support of MTA were borne by non-MTA residents; only about 8 per cent of the MTA subsidy was received by non-MTA residents. In 1962 this net import of MTA subsidy amounted to approximately 1.8 million dollars. It is important to note that the exported taxes were paid not only by residents of Eastern Massachusetts who presumably have potential access to MTA service, but also by persons living in other areas of the United States who do not have such access.

Within the MTA district there were only two income groups receiving no net benefit--the richest and poorest ones. The highest income group paid approximately 800 thousand dollars more in taxes than they received in the form of subsidized transit service. The lowest income group broke even. They paid about

the same amount in taxes as they received in subsidized transit service. The households showing a net benefit by income classification were those with annual incomes ranging from four to fifteen thousand dollars. This large, middle portion represented 70 per cent of all MTA households.

Table 5.1
DISTRIBUTION OF NET DIRECT BENEFITS
AMONG MTA RESIDENTS

Income Group	Direct Costs	Direct Benefits	Net
Under - $ 3,999	14%	14%	0%
4,000 - 4,999	6	8	+2
5,000 - 5,999	9	12	+3
6,000 - 6,999	8	12	+4
7,000 - 7,999	8	11	+3
8,000 - 9,999	11	12	+1
10,000 - 14,999	13	16	+3
15,000 - Over	12	7	-5
Exported	19	8	-11
Total	100%	100%	0

Source: Table 4.11; Table 3.9

An important reminder: the net direct benefits in Table 5.1 are estimates of averages for each income group. It is safe to assume that any MTA household using transit service regularly, regardless of which income group it was in, received a positive net direct benefit from the MTA subsidy. Obviously, the non-users in all income groups received a minus net direct benefit. Since on the whole the lowest income group received zero net direct benefit, the subsidy received by low income users

of MTA, came, in effect, from the poor who did not use MTA services.

Table 5.2 shows the distribution of net direct benefits among all households either paying taxes which support the MTA or using MTA services. When net direct benefits are accounted in this larger context the general effect of MTA subsidy on the various income groups remains essentially unchanged. The primary beneficiaries are still the middle income groups. The richest and poorest groups show a further increase in minus net direct benefits because in each case their share of the export taxes in greater than their share of the export transit service.

Table 5.2
DISTRIBUTION OF NET DIRECT BENEFITS

Income Group	Direct Costs	Direct Benefits	Net
Under - $ 3,999	16%	14%	-2%
4,000 - 4,999	7	9	+2
5,000 - 5,999	10	12	+2
6,000 - 6,999	10	13	+3
7,000 - 7,999	9	11	+2
8,000 - 9,999	13	15	+2
10,000 - 14,999	17	18	+1
15,000 - Over	18	8	-10
Total	100%	100%	0

Source: Table 4.12; Table 3.2

The poorest group pays a small portion of the exported taxes (11 per cent from Tables 4.10 and 4.11) but their share of the exported service is almost zero (4 per cent shown in Table 3.4).

The richest group receives 15 per cent of exported service (Table 3.4) and pay 32 per cent of exported taxes (Tables 4.10 and 4.11).

Effect of Systematic Study Biases

In assessing the findings of this analysis it is worthwhile to briefly consider how systematic biases caused by the methodology and accompanying assumptions might have affected the results. Of the assumptions in this category, three of them are most obvious.

1. In estimating the cost of a transit trip the differences between peak and off-peak travel were ignored. This had the effect of understating the net direct benefits received by higher income groups.

2. In determining the incidence of residential property taxes it was assumed that the tax burden was proportional to value of the home or the level of gross rent. The effect of this assumption is to understate the direct costs to lower income groups and thereby overstate their net direct benefits.

3. The estimates of export rates were, in general, conservative ones. Because the incidence of exported taxes falls more heavily on higher income groups than the taxes not exported, this aspect of the analysis overstates the direct costs to lower income groups and thereby understates their net direct benefits.

Although the exact effect of these biases is not clearly known, there seems justification to state that the net direct benefits of subsidy to the poor are not underestimated. Nor

does it seem likely, that the net direct benefits to the higher income groups have been overestimated.

Deficit Apportionment Formula

The incidence of benefits among the MTA member communities is important because it can affect the distribution of net direct benefits among income groups. In addition, the benefit received by member communities was a highly publicized controversy due to the political context in which the MTA deficit was apportioned to the fourteen communities. In an issue of the Newsletter of the Institute for Rapid Transit, this observation was reported:

> For many years, the MTA had been operating with large annual losses which were made up by the 14 cities and towns which it served. There was much dissatisfaction over the actual municipal payments for the losses, but also with regard to the apportioning of the losses among the various cities and towns.[1]

The Massachusetts Legislature was also concerned about the allocation of the deficit among the member communities of the MTA. The Legislature's intention that one community not be charged with the cost of another community's unprofitable transit service was made clear when it provided that:

> The loss attributable to each route in each such city or town shall be determined by the authority in accordance with sound accounting practice on the basis of the difference between the revenues from such route in such city or town and the cost of providing such route therein.[2]

The assessment of deficit to a town on the basis of transit routes operating within its boundaries differs from this study's method of allocating deficit on the basis of transit usage by

the residents of a particular town. (Although the methods differ, their intent, undoubtedly is similar--to allocate deficits in a manner that reflects patterns of benefit.) Despite these differences, the findings of this study give some information about how well the communities fared relative to one another.

Table 5.3 compares the percent distribution of assessed deficit with the distribution of direct benefits by city and town. It should be kept in mind that the assessed deficit apportioned to each community does not necessarily equal direct costs to the community since part of the deficit is paid through exported taxes. Although nearly a fifth of the total taxes were exported, none of the deficit was assessed to communities outside the MTA district. The direct costs of the MTA subsidy is not known for each MTA community because export rates were not estimated for each town, but only for the total. Nevertheless, the information in Table 5.3 gives some information about the 'fairness' of the apportionment formula.

In general, Table 5.3 suggests that the effect of the apportionment formula was to increase the tax burden of the MTA subsidy on low income families relative to higher income ones. Boston and Cambridge with low family incomes are assessed more of the deficit than they receive in benefits. At the other end, the high income areas of Newton and Arlington receive more in benefits than they are assessed in deficit. This trend, however, is not that consistent. Consider the cases of Brookline and Chelsea.

Table 5.3
COMPARISON OF DEFICIT APPORTIONMENTS
AND DIRECT BENEFITS

MTA Community	% Assessed Deficit	Direct Benefits	Net Difference	Median Family Income
Boston	64%	52%	-8%	$ 5,700
Cambridge	9	7	-2	5,900
Brookline	4	3	-1	8,400
Malden	3	3	0	6,200
Everett	2	2	0	6,000
Revere	2	2	0	5,900
Belmont	1	1	0	8,400
Watertown	1	1	0	7,000
Milton	1	1	0	8,700
Somerville	5	6	+1	6,000
Medford	3	4	+1	6,700
Chelsea	2	3	+1	5,300
Arlington	2	4	+2	7,500
Newton	1	3	+2	9,000
Exported	0	8		
Total	100%	100%		

Source: 1960 Census of Population; Table 3.8; Table 4.2

In addition to the inconsistency, another mitigating condition is the fact that Cambridge and Boston because of their property tax base have a larger share of their taxes exported than the other communities. (The residential property taxes in these two cities, which have a very regressive incidence, are certainly not exported.) Furthermore, the Boston and Cambridge shares might be justified on the basis of direct and indirect benefits not included in this study, because by far the largest share of MTA service was physically located and served the commercial properties within these two communities.

Focusing only on the distribution of net direct benefits

among income groups, Table 5.3 indicates that a more uniform assessment of the deficit in proportion to direct benefits would have increased the net direct benefits to lower income groups. The increase, however, would probably have been slight.

Change of Study Results Over Time

Since the base of this study has been the early 1960's, the way in which the study's results might have changed in the intervening years needs to be examined, even if its only in a brief and cursory manner. Primary attention in this mainly qualitative assessment will be on the changes in the provision and financing of public transportation.

In 1964 the Metropolitan Transit Authority was replaced by the Massachusetts Bay Transportation Authority (MBTA) through state legislation.[3] The MBTA district includes the original member communities of the MTA (commonly referred to as the Inner 14) plus sixty-five other Eastern Massachusetts communities (Outer 65). Changes in the coverage and type of transit service and deficit-financing accompanied the major reorganization. The year 1968 is the reference year for examining these changes.

In the absence of data on individual usage of MBTA services by income, the best that can be done is to look at the consequences of specific service changes for the various income groups. The MBTA bus services extending out beyond the original MTA service area amounted to 30 per cent of total MBTA bus service on the basis of revenue miles of service.[4] (Not all

of the Outer 65 had direct MBTA bus service though.) Given the general differences in family income between inner and outer communities of metropolitan areas, it is unlikely that this additional bus service could have increased the lower income group's share of total public subsidy to bus service. Moreover, the cost of providing bus service in areas of low population density is normally increased because of reduced load factors.

The routes of rapid transit and streetcar service remained essentially unchanged during the 1960's. Construction of a new rapid transit extension to Quincy on the south shore was, however, in progress. Judging from the previous extension of streetcar service to the outer fringe of the MTA in 1959 (Highland Branch), the south shore extension will have users with higher than average incomes.

Table 5.4
FAMILY INCOME OF HIGHLAND BRANCH USERS

Income Group	Per Cent Distribution
Under - $ 3,000	4%
3,000 - 5,000	9
5,000 - 7,000	17
7,000 - 10,000	25
10,000 - 15,000	24
15,000 - Over	21
Total	100%

Source: Greater Boston Economic Study Committee Survey

Table 5.4 shows an example of the pattern of usage of transit service extended into suburban areas: for comparison,

see Table 3.5. Thus, the construction of rapid transit and streetcar routes into the suburbs will increase the higher-income group's share of transit service.

In addition to bus and subway service, the MBTA was providing subsidy for operation of two commuter trains: the Boston and Maine; and the New York, New Haven, and Hartford.[5]

Table 5.5
ANNUAL INCOME OF BOSTON-MAINE RAILROAD COMMUTERS

Income Group	Per Cent Distribution
Under - $ 4,000	10%
4,000 - 6,000	20
6,000 - 8,000	20
8,000 - 10,000	18
10,000 - 15,000	21
15,000 - Over	11
Total	100%

Source: Massachusetts' Mass Transportation Commission Survey

Table 5.5 shows the extent to which the higher income groups rode the commuter trains. Their share of total ridership was much greater than their share of total population.

None of the changes in transit service between 1962 and 1968 seemed to be of special benefit for lower income groups. In fact, the evidence suggest that higher income individuals were the primary users of the expanded services.

During the 1960's the primary cause of increases in the

cost of providing transit service were increases in labor costs. Because buses are more labor-intensive than subways, the portion of total deficit attributed to buses increased from 58 per cent to 65 per cent between 1962 and 1968.[6] Since buses were used more than subways by the poor, these circumstances increase their share of the total subsidy relative to higher-income groups. (A mitigating fact, as mentioned earlier, however, is the significant portion (30%) of the bus service going to the Outer 65 communities.)

With the establishment of the MBTA came a re-structuring of the financing of MBTA's costs in excess of income. In 1968 Massachusetts taxpayers were assessed approximately $40 million in taxes for MBTA's fiscal maintenance.[7] Of this, the local assessment to MBTA member communities was $28 million, while the remaining $12 million was levied on state taxes collected throughout Massachusetts.

The local share, apportioned among the 79 member communities, was paid with the property tax revenues of these communities. Although all 79 cities and towns were assessed some of the local share, little of the burden of transit subsidy was shifted away from the former MTA communities. Their portion of the local share was 91 per cent in 1968.[8] Thus, the incidence of the 28 million dollar local share was probably not very different from the tax incidence analysis presented in Chapter 4.

Most of the state subsidy came from the Massachusetts' cigarette tax.[9] The incidence of this tax can be estimated by examining patterns of tobacco consumption among various income groups.

Table 5.6

INCIDENCE OF MASSACHUSETTS CIGARETTE TAX

Income Group	Per Cent Distribution
Under - $ 3,999	8%
4,000 - 4,999	9
5,000 - 5,999	11
6,000 - 6,999	13
7,000 - 7,999	12
8,000 - 9,999	20
10,000 - 14,999	15
15,000 - Over	12
Total	100%

Source: Bureau of Labor Statistics; 1960 Census of Population

Table 5.6 shows that the direct costs of the state subsidy to MBTA are distributed significantly different among income groups then the local share. (For illustration, compare Tables 4.10 and 5.6). The lowest group and the two highest groups bear smaller proportions of the state subsidy than the local subsidy. Because the cigarette tax is levied throughout the Commonwealth, state support of the MBTA increases the subsidy of MBTA users by non-users.

An additional source of revenue for public transportation after the mid-1960's was the federal government. In 1968 MBTA was the recipient of about 7 million dollars in federal mass transportation capital grants.[10] About four-fifths of the total was spent on rapid transit facilities. This money did not go to subsidize unprofitable operations; instead it was used to

expand and upgrade service. The consequences of primary attention on subway facilities is to improve the service of the higher income groups relative to the poorer ones.

Shifts in population and employment would affect transit usage. It is likely that outward migration of higher income families occurred in the Boston region during the 1960's. In general, it would seem that the effect of this shift on transit usage would be relative decreases in ridership by higher-income persons because of an over-all lowering of their access to or need for MBTA services. Given that much of the local subsidy remained a burden of the Inner 14, the increasing concentration of lower income households in the region's core would mean an increase in their share of the direct costs of MBTA subsidy.

Relocation of employment opportunities would affect transit ridership because of the preponderance of work trips among total transit trips. The manufacturing sector has had the fastest rate of exit to the outer rings of the metropolitan area.[11] Since the primary source of work for the low-skill individual is manufacturing, there is reason to believe that transit access to employment decreased the most for lower income groups. Conversely, the CBD with its concentration of highly paid executives and professionals remains the employment area with highest transit access.

The evidence regarding changes in the beneficiaries of the net direct benefits of subsidy by income during the 1960's is neither clear nor one-sided. The poor seemed to benefit least from new transit services offered by MBTA. The poor paid

for a smaller share of the subsidy to MBTA because of state financial assistance; but then, state subsidy also reduced the relative burden for the two highest income groups. The relocation of higher-income families was reducing their proximity to transit service, and so, they were probably using it less. The employment opportunities of the poor were also moving away from transit service, and consequently transit work trips by the poor probably decreased relatively.

In summary, there is little reason to suspect that the lowest income group greatly increased it share of the net direct benefits of transit subsidy between the beginning and end of the last decade.

Chapter 6: Conclusions

General Effect of Transit Subsidy

As pointed out in the Introduction to this study, "...virtually the only rationale offered for maintaining transit fares below market value is to provide cheap transportation for poor people."[1] The provision of transportation for persons who cannot drive is seen as an accompanying objective. How did the subsidized MTA service measure up to these criteria?

Analysis of the subsidy to MTA in 1962 shows that the lowest income group's savings from lower transit fares were consumed by the taxes they paid to support to subsidy. Those low income families using transit service regularly, undoubtedly, spent less on transportation, including tax costs, than they would have without it. On the other hand, for the families with annual incomes below $4,000, who maintained an automobile and relied primarily on it for transport, the tax burden of MTA subsidy amounted to added transport costs for unused service.

Just as the direct benefits of the subsidy were not the sole possession of the poor, neither were they that for the young and elderly and others unable to drive. (Half of all transit users resided in households owning at least one automobile; 52 per cent of all transit riders were licensed drivers.[2]) While the young and elderly constituted about 38 per cent of the MTA population, their share of the direct benefits of subsidy was only 28 per cent.

The income groups with annual incomes between four and fiteen thousand did have their public transportation costs reduced by the MTA subsidy. Their share of direct benefits exceeded their proportion of the taxes levied to finance the

subsidy. Their savings from transport costs were derived from the taxes borne by the highest income group. The identification of this primary beneficiary group leads to the general conclusion that the MTA subsidy was effective in assisting those who used transit service as a means of getting to and from work. (Work trips were about 60 per cent of total transit trips.[3]) From these facts the inference is made that the primary result of the public policy of subsidizing MTA was to reduce the commuter's cost of going to work by transit, as opposed to aiding the poor or those too young or too old to drive.

Review of available data on the distribution of transit subsidies in other cities suggests conclusions similar to those drawn in this study. Consider these remarks made by Martin Wohl at a Transportation and Poverty Conference sponsored by the Americ n Academy of Arts and Sciences:

> It is very difficult not to come to the conclusion that there is a perverse income transfer...The data I can pull together says fairly strongly that transit users are a well-to-do group in the aggregate. I also point out that they include people at both ends of the income spectrum and one tends to outweigh the other. As a result, transit subsidy is not a very efficient device for helping the poor specifically.[4]

Mr. Wohl's observation was based on his analysis of national data on transit usage and specific cases in Chicago, New York, and other cities.

Efficacy of Policy Alternatives

The distribution of net direct benefits of transit subsidy

is the product of two sets of policies--one which shapes the transit service provided and the ohter which determines the way the subsidy is financed. Part of the value of a detailed analysis is insight into the contributions of various component elements of a policy to the overall effect of the policy.

If, in this case, increasing the poor's share of net direct benefits of subsidy was an objective, what changes in transit service policy would have contributed to that end? Contrary to much speculation, changing from a flat-fare structure to a graduated fare system would not have given any special aid to the poor. Differential fares for peak/off-peak periods would have left the lower income groups better off, but the improvement of their situation would have been slight. Reduced fares for the elderly would have worked to the poor's advantage; reduced children's fares on subways, only, did little for the lowest income groups. Similar reductions on the buses would have increased the poor's share of total subsidy.

In general, improvements of bus service would be better from the low-income rider's perspective than subway improvements. In particular, radial extensions of rapid transit lines do very little for the poorer transit users. (Several studies[6] on the local and federal contributions to new radial transit routes shows distribution of benefits highly skewed toward the upper end of the income scale.)

Even though the service policies which do the most to lower the direct costs of transportation for low-income groups can be identified, the use of public transit is so evenly

spread over the total income range (see Table 3.2) that general service policy options are really an ineffective means of reducing the poor's costs of public transportation. For example, the households having annual incomes in excess of $8,000 even utilized a significant portion (37 per cent) of MTA bus services in 1962.

The policies determining how the transit subsidy is financed have, obviously, a significant effect on the distribution of net direct benefits among income classes. In order to examine the effect of various taxing schemes that might be used to pay for the subsidy, all that is necessary is to compare the fairly well-known incidence patterns of the taxes. The range of possible revenue sources includes the local property tax, a state tax on consumption (sales tax), and the federal income tax. For example, comparison of the net direct benefits of subsidy, assuming the subsidy was financed through any of the tax sources listed above, is shown in Table 6.1.

The more progressive the tax structure, the more the poorest benefit from subsidized transit service. The income tax need not be only a federal instrument. For the most part, a municipal or state income tax could, conceivably, aid the lower income groups just as well as the federal one. (Although up until this time, most state and municipal income taxes have not had the degree of progressivity present in the federal income tax.)

Table 6.1 shows clearly how significantly the tax source affects the net direct benefits. Also evident in the table is the extent to which the tax alternatives have distinct consequences of a large magnitude for each income group.

Table 6.1

COMPARISON OF SUBSIDY EFFECTS UNDER LOCAL, STATE, AND FEDERAL FINANCING

Income Group	Direct Benefits	Local Property TAx		State Sales Tax		Federal Income Tax	
		Direct Costs	Net Direct Benefits	Direct Costs	Net Direct Benefits	Direct Costs	Net Direct Benefits
Under - $ 3,999	14%	16%	-2%	9%	+5%	3%	+11%
4,000 - 4,999	9	7	+2	6	+3	5	+4
5,000 - 5,999	12	10	+2	10	+2	6	+6
6,000 - 6,999	13	10	+3	11	+2	7	+6
7,000 - 7,999	11	9	+2	11	0	11	0
8,000 - 9,999	15	13	+2	15	0	11	+4
10,000 - 14,999	18	17	+1	20	-2	21	-3
15,000 - Over	8	18	-10	18	-10	36	-28
Total	100%	100%	0	100%	0	100%	0

Source: Tax Foundation, Inc.; Bureau of Labor Statistics; 1960 Census of Population; Table 5.2

Summary

The transit subsidy reduces the cost of public transportation more for the middle-income commuters than for those too young, too old, or too poor to drive. Because transit service is used by people of all incomes, general changes in pricing and provision of service will do little to specifically aid the poor. The choice of financing mechanism for the subsidy is the prime determinant of the subsidy's impact on the various income groups.

Appendix A: Description and Application of the EMRPP Survey

Part I

Basic Data Collected

The EMRPP dwelling-unit survey was conducted through home interviews and gathered information in three general categories: (1) description of household characteristics, (2) description of individuals residing in the household, and (3) description of each one-way person trip made during the previous 24 hour period by all persons over five years of age in the household. These basic data were transcribed onto 'record' magnetic computer tape (2,400 feet of IBM Mylar, written '10 x 84' with no header or trailer to a density of 556 or 886 BPI) and labeled E/MASS/HOUSEHOLD FILE, E/MASS/PERSON file, and E/MASS/TRIP FILE.

This study used the E/MASS/TRIP FILE, identified as EMRPP computer tape no. 002. Computations from this tape were made at M.I.T.'s Information Processing Center.

E/MASS/TRIP FILE

The trip data file gave information about the transit trip-maker and transit trip.

I. The Trip-maker:

A. Residence

1 Arlington
2 Belmont
3 Boston
4 Brookline
5 Cambridge
6 Chelsea
7 Everett
8 Malden
9 Medford

10 Milton
11 Newton
12 Revere
13 Somerville
14 Watertown
15 Outside MTA

B. Age
1 5-15 years
2 16-59 years
3 60 and over

C. Annual Family Income
1 $ 0-3,999
2 4,000-4,999
3 5,000-5,999
4 6,000-6,999
5 7,000-7,999
6 8,000-9,999
7 10,000-14,999
8 15,000-25,000
9 25,000 and over

II. The trip:

A. Type of transit vehicle
1 Motor and trolley buses
2 Subway ans streetcars

B. Origin/Destination of trip
1 Arlington
2 Belmont
3 Boston
4 Brookline
5 Cambridge
6 Chelsea
7 Everett
8 Malden
9 Medford
10 Milton
11 Newton
12 Revere
13 Somerville
14 Watertown

C. Time of day
(All hours of the day within six minute intervals)

D. Day of week
1 Sunday
2 Monday
3 Tuesday
4 Wednesday
5 Thursday
6 Friday
7 Saturday

E. Travel time of trip

1	0-12 Minutes
2	13-18
3	19-24
4	25-30
5	31-36
6	37-42
7	43-48
8	49-54
9	55-60
10	61-66
11	67-72
12	73-78
13	79-84
14	84-90
15	90 and over

'EFFECT' Language

EFFECT is a simple computer language that is capable of manipulating large files of data by means of an empirical function evaluator. It was designed to keep the data in its most basic form allowing the user to determine the level at which the data would be used. For example, in the case of survey files, the data are left at the level of the coded answers of the individual respondents. EFFECT extracts data in the form of multi-dimensional arrays, which may be output in labeled tabular form or used for input to other programs.

Figure A.1 shows the job control language needed to initiate computer processing. Figure A.2 is an example of an EFFECT program. Figure A.3 is an exhibit of output printed in tabular form.

```
JOB ORIGIN FROM LOCAL DEVICE=RD2      ,002.
//J00967   JOB 1,
//  'RLSCHULZE'          DESCRIPTION OF MBTA RIDERS
/*MITID PROB=M3829,PROG=2882
/*SRI 4
/*MAIN TIME=6,LINES=6,CARDS=1
/*SETUP DDNAME=FILE,DEVICE=2400-9,ID=(000031,NORING,SAVE,SL),A=WVK,
/*C='USING M3829-2882 TAPE'
// EXEC FORG,PROG='USERFILE.M6016.6589.LOAD.CLR(EFFECT)'
//G.FILE DD DSNAME=PACKED,UNIT=2400-9,VOLUME=SER=000031,
//             LABEL=(1,SL),DISP=OLD
//G.SYSIN DD *
/*
```

'EFFECT' JOB CONTROL LANGUAGE

Figure A.1

```
**** E F F E C T

      USE_FILE EMASS_TRIP
      COMBINE R_TOWN-INTO-MTA 37+41+153-165+90+45+134+51+60+63+102+66+135+72'
      +80
      COMBINE D_TOWN-INTO-MTD 37+41+153-165+90+45+134+51+60+63+102+66+135+72'
      +80
      COMBINE C_TOWN-INTO-MTD 37+41+153-165+90+45+134+51+60+63+102+66+135+72'
      +80
      COMBINE R_TOWN-INTO-R_MTA 37,41,153-165,90,45,134,51,60,'
      63,102,66,135,72,80
      COMBINE AGE-INTO-SCHOOL_KIDS 0+1
      COMBINE AGE-INTO-ELDERLY 8+9
      COMBINE INCOME_LEVEL-INTO-INCOME 1,2,3,4,5,6,7,8+9
      COMBINE MODE-INTO-BUS 6
      COMBINE MODE-INTO-SUBWAY 5
      COMBINE MODE-INTO-PUBTPN 5,6
      COMBINE TRIP_COST-INTO-BUSFARE 0+1-10,11-20,21-25,26-999
      COMBINE TRIP_COST-INTO-SUBFARE 0+1-10,11-20,21-30,31-40,41-999
      COMBINE TRIP_COST-INTO-FARE 0+1-10,11-20,21-25,26-30,31-40,41-999
      TABULATE 88 SCHOOL_KIDS.SUBWAY.INCOME SB TRIP_FACTOR
      TABULATE 92 SCHOOL_KIDS.MTD.MTO.BUS.INCOME SB TRIP_FACTOR
      EXECUTE
EXECUTION BEGINS
```

EXAMPLE OF 'EFFECT' PROGRAM

Figure A.2

TABLE EH1

INCOMEEL .VS. AUTOS_EC

	ZERO	ONE	TWO	THREE	4/MORE	TOTAL
UNKNOWN	45104.	52556.	12379.	1915.	348.	112301.
UNDER4K	62581.	20577.	499.	48.	57.	83762.
4K-5K	19550.	23288.	1374.	121.	0.	44334.
5K-6K	14548.	34657.	2153.	125.	0.	51483.
6K-7K	9099.	27633.	3394.	48.	0.	40174.
7K-8K	5884.	21688.	3929.	238.	0.	31739.
8K-10K	5414.	24253.	6141.	256.	35.	36099.
10K-15K	3181.	21801.	9762.	1025.	45.	35814.
15K-25K	1042.	5477.	6755.	1475.	193.	14942.
25KABOVE	399.	1971.	2913.	661.	152.	6096.
TOTAL	166803.	233901.	49298.	5912.	830.	456744.

'EFFECT' OUTPUT IN TABULAR FORM

Figure A.3

Part II

Application of EMRPP Survey

The MTA district was only a part of the entire area covered by the EMRPP dwelling-unit survey. The accuracy of the survey methods over the entire area was established by the original study team by comparing the survey data with other sources of similar data.[1] In general, the accuracy checks demonstrated the reliability of the sampling procedures employed.

Since this study used only part of the survey results, it seemed desirable to establish some measure of the EMRPP survey's reliability within the MTA district. The applicability of the EMRPP survey to only the MTA district was tested by comparing population estimates based on the survey and the U.S. Bureau of Census.

The Census estimate of MTA population in 1962 was made by updating the 1960 Census reports on the basis of changes in the MTA population evident in the Massachusetts State Census records of 1955 and 1965. (Essentially, it was assumed that the yearly rate of change in the U.S. Census estimate would be the same as the average yearly rate of change calculated from the 1955 and 1965 Massachusetts Census records.)

Table A.1
COMPARISON OF MTA POPULATION ESTIMATES
OF THE U.S. CENSUS AND EMRPP SURVEY

	U.S. CENSUS ESTIMATE	EMRPP SURVEY ESTIMATE	Per Cent Difference
MTA Population	1,403,500	1,398,300	0.4%

Source: 1960 Census of Population; Massachusetts State Census; EMRPP Dwelling-Unit Survey

Table A.1 suggests that applying the EMRPP dwelling-unit survey to only the MTA district does not undermine the survey methodology.

In addition, the data on MTA transit trips collected in the EMRPP dwelling-unit survey was checked against similar information gathered in a transit postcard survey. The results of the two surveys were fairly compatible.[2]

Adjustment for No Response on Family Income

The primary difficulty in using the EMRPP survey was adjusting for dwelling units that did not report annual income. Annual family income was unknown for nearly one-quarter (24%) of dwelling units interviewed in the MTA district. Merely ignoring the non-reporting units would have biased the sample.

As a means of determining the extent to which the various income groups were under-reported, a profile of income distribution in the MTA district was estimated from Bureau of the Census

data. The 1959 family incomes for the fourteen cities and towns (reported in the 1960 Census) were updated to the year 1962 on the basis of nationally recorded increases in family income. It was assumed that changes in family income for the MTA district were identical to general changes as reported in the Statistical Abstract of the United States.

Table A.2
COMPARISON OF U.S. CENSUS AND EMRPP SURVEY ESTIMATES OF THE DISTRIBUTION OF FAMILY INCOME

Income Group	EMRPP Survey	U.S. Census	Ratio of Census:Survey
Under - $ 3,999	18%	22%	1.2
4,000 - 4,999	10	10	1.0
5,000 - 5,999	11	11	1.0
6,000 - 6,999	9	12	1.3
7,000 - 7,999	7	10	1.4
8,000 - 9,999	8	13	1.6
10,000 - 14,999	8	14	1.7
15,000 - Over	5	8	1.6
Unknown	24	--	
Total	100%	100%	

Source: EMRPP Dwelling-Unit Survey; 1960 Census of Population; Statistical Abstract of the United States

Table A.2 shows how ignoring the unknown group would have biased the sample of transit ridership. The most severe under-reporting is present among the higher-income groups, although the lowest income group was also reluctant to divulge their annual income. In order to compensate for the non-reporting dwelling units, the census:survey ratios were used to adjust each tabulation of transit usage by income.

Appendix B: Distribution of Assessed Valuation By City and Town

Assessed Valuation by Land Use

The first step in estimating the incidence of the local property tax subsidizing the MTA is to determine the break-down of real estate valuation by land use for each MTA city and town. The five land use categories are: (1) single family residence, (2) multi-family residence, (3) commercial, (4)manufacturing, and (5) miscellaneous.

This information was gathered from several sources, and in some cases, it was necessary to up-date the reported distribution of assessed valuation or estimate the distribution on the basis of data repórting acres per land use category.

The distribution of assessed valuation for Boston, Cambridge, Newton, Brookline, Somerville, and Belmont was reported in the 1962 Census of Governments, Vol. II Taxable Property Values. The information on the other communities was estimated from an unpublished report of the Massachusetts Taxpayers Foundation, Property Tax Burden, and the Greater Boston Economic Study Committee's research report, Boston Land Use in 1960: Land Use Report #1.

Table B.1 shows the break-down of assessed valuation by city and town.

Table B.1

DISTRIBUTION OF ASSESSED VALUATION BY TOWN

Community	Single-Family Residence	Multi-Family Residence	Commercial	Manufacturing	Other	Total
Arlington	56%	25%	8%	7%	4%	100%
Belmont	76	11	6	5	2	100
Boston	11	31	36	15	7	100
Brookline	53	29	14	2	2	100
Cambridge	38	12	19	29	2	100
Chelsea	7	35	35	18	5	100
Everett	6	31	9	20	34	100
Malden	30	37	21	7	5	100
Medford	79	4	11	5	1	100
Milton	83	5	6	2	4	100
Newton	75	8	10	6	1	100
Revere	12	50	21	10	7	100
Somerville	58	3	21	11	7	100
Watertown	30	34	15	15	6	100

Source: Census of Governments; Massachusetts Taxpayer Foundation; Greater Boston Economic Study Committee

Appendix C: Manufacturing Employees of National Corporations

Employees of National Manufacturing Corporations

The Industrial Directory 1962 prepared by the Massachusetts Department of Commerce lists all manufacturing firms in the state by location giving the approximate number of employees. Of these firms located within the MTA district the corporate stock of twenty-three of them was traded on either the American or New York Stock Exchanges.

Table C.1
LOCATION AND NUMBER OF EMPLOYEES OF SEVEN LARGEST NATIONAL MANUFACTURING CORPORATIONS IN MTA DISTRICT

Corporation	Plant Location	Number of Employees
Gillette	Boston	3,500
Honeywell	Boston	7,500
Westinghouse	Boston	2,500
United Car Fasterner	Cambridge	2,500
Polaroid	Cambridge	4,500
Raytheon	Newton	10,000
Goodrich	Watertown	4,500
Subtotal		35,000
Other 16		7,500
Total		42,500

Source: Massachusetts Department of Commerce and Division of Employment Security

The employee size of the plants was approximated as the mean of the range of the category in which each was identified.

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